MANAGEMENT OF THE PRODUCTION FUNCTION OF DATA PROCESSING

by

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CHAPTER I

INTRODUCTION

Historians will probably describe the current period of history as an age of conscious social change: conscious, in that one reads and hears about it constantly. This thesis is not different. Without change, however, there would appear to be little progress. Changes which are happening include: the rapid growth of population; the massive flow of people from rural areas to cities; the steady growth of national income and wealth; the rise of oppressed and submerged people; the rebellion of youth; the spread of mass education; the extension of leisure; and, the venture to the moon. Men have learned the power of applying thought and experiment to the attainment of human ends and have systematically exploited the possibilities of pure science and technology, a steady flow of new methods, new designs, and new products have resulted.[1]

In 1887, two independent events occurred which would have a significant impact on the business world. The American Institute of Certified Public Accountants was founded and Herman Hollerith first field-tested his Electronic Tabulating System in the city of Baltimore.[2] During the intervening eighty-three years, many improvements and changes have taken place in the business world, and in the equipment used to process business

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[1]U. S. National Committee on Technology, Automation and Economic Progress, Technology and the American Economy, Vol. 1, February, 1966, (Washington, D. C.: Government Printing Office, 1966), p. xi.

[2]Herbert C. Willis, "The Auditor and the Computer," Selected Papers 1964, (Haskins and Sells, 1964), p. 147.

data. Progress has been from the basically manual methods through bookkeeping machines and punched card tabulating equipment, and now into the era of Electronic Data Processing.

Among the new products developed during this era of change was one which resulted from the labors of Dr. J. Mauchly and Mr. J. Eckert -- the first high-speed electronic device able to do great quantities of statistical calculations in a short period of time. The Electronic Numerical Integrator and Calculator (ENIAC) was completely electronic in that it had no moving parts and was able to accomplish in a day a job that would require 300 days to complete by manual methods.[1] As of June 30, 1966, the Bureau of the Budget inventory listed 2,623 general purpose digital computers in thirty-five Federal agencies and, during the same fiscal year, there were 60,000 man-years associated with automatic data processing in the Federal Government.[2] Acquisition and operation of data processing equipment resulted in the expenditure of $1.1 billion in 1966.[3] In June of 1968, there were forty-three agencies of the Federal Government operating 4,232 computer systems at a total asset value of over $3 billion.[4]

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[1]Elias M. Awad, Automatic Data Processing Principles and Procedures, (Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1966), p. 26.

[2]U. S. Bureau of the Budget, 1966 Inventory of Automatic Data Processing (ADP) Equipment in the Federal Government, (Washington, D. C.: Government Printing Office, 1966), p. 7.

[3]Fred R. Brown, Management Concepts and Practice, (Washington, D. C.: Industrial College of the Armed Forces, 1967), p. 198.

[4]U. S. Bureau of the Budget, Government-wide EDPE Utilization, Report No. 3A, November 25, 1968, p. 32-34.

Uses of the computer in the government include business, scientific, financial and engineering. The computer affects almost every major government activity, and almost every type of application possible. There are probably more applications for computers than there are computers. As the technology has advanced, the number of applications has grown at an exponential rate.[1] The Federal Government is becoming virtually dependent upon the computer as a tool of both operation and management. This explosive growth has lead to investments in the billions of dollars by, or at the expense of, Federal agencies. Indeed, this expansion has appropriately caused the electronic computer to be regarded as a major and vital resource to accomplish the primary responsibilities of Federal agencies.

It soon became evident to elements within the Executive and Legislative Branches of government that, although the computer was particularly suited to the complex and voluminous data processing needs of the agencies, it was also expensive. It not only consumed about three per cent of the annual appropriations, but it required large numbers of highly trained personnel. More efficient use of government automatic data processing resources is not only desirable, but would appear to be mandatory. In 1965, the President requested the Bureau of the Budget to investigate and to recommend any action which was considered necessary for the improvement of data processing management. In the same year, Congress passed

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[1] Fred R. Brown, Management Concepts and Practice, (Washington, D. C.: Industrial College of the Armed Forces, 1967), p. 199.

Public Law 89-306, which is a statement of Congressional intent with regard to data processing management in the Federal Government. In general, Public Law 89-306 and the Report to the President on the Management of Automatic Data Processing (ADP) were concerned with the control of data processing costs by improving equipment acquisition and utilization, and also by improving the availability of information concerning equipment currently installed in the government.

Although much has been written about the various segments of data processing management, little has appeared in any detail to assist the daily practitioner in solving the varied and pressing problems associated with the operating function of data processing management. This appears to be true for both top management, who has the responsibility for evaluating the contributions made by the data processing function to the accomplishment of the activity's mission, and also for data processing management itself. It seems that top management has often neglected its responsibility. Whereas, computer center operational personnel appear to be busy in the machine room trying to squeeze an inventory update between demand processing and payroll, or negotiating with service personnel on whether they can have the computer between 5 a.m. and 6 a.m. The operations manager may also be busy explaining to higher management about security of tape files, equipment utilization, manpower needs, or more importantly, why a customer's output was late. These are but a few of the normal and

and repetitive problems encountered by the operations manager of a Data Processing Center.

Joseph J. Wasserman, President of Computer Audit System, states:

> Many companies are working to develop new business applications for electronic data processing. All too often this effort is not accompanied by a proportional effort to develop computer control systems which will protect the company's assets from misuse or error. Yet the importance of effective computer control is increasing, for a number of reasons:
>
> 1. The growing size and complexity of EDP systems, which make errors more costly and more difficult to detect;
>
> 2. The sophistication of third-generation hardware, where original documents may exist only in the form of magnetic records within the computer, placed there directly from remote terminals;
>
> 3. The growing reliance of management on information generated by computer systems, not only for financial data but also in such areas as marketing, production, engineering, and forecasting; and,
>
> 4. A continuing shortage of trained computer personnel, which leads to high turnover and hiring of marginal workers. [1]

From the above, it can be seen that increasing emphasis will be placed on management of the production function of the data processing center. The production function is defined to include all work performed by the Operations Division of the Data Processing activity which has been accepted as reoccurring effort or is a special processing for a customer. Since the production function is basically a service to a customer, it would appear that the responsibilities of the Operations Divison would require input to be processed efficiently, completely, accurately, economically and timely. In addition, it is essential that the customer be provided status on his

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[1] Joseph J. Wasserman, "Plugging the Leaks in Computer Security," Harvard Business Review, September-October, 1969, p. 120.

production workload (based on the principle of management by exception).

Maurice S. Newman of Haskins and Sells, has noted:

> Much of the work done in data processing departments is careless and disorderly. In only a few installations are quantitative standards found. Quality standards are all too rarely set, let alone observed. Output is, in some cases, quite low, and often incorrect. This leads to confusion and a general lack of confidence in the installation, which could often have been prevented by adequate quality controls.
>
> There has always been a general awareness of the problem of internal control in computer installations, but that cognizance has often remained with the accountant and has not been adequately communicated to those dealing directly with the equipment.
>
> . . . Accountants can recognize weaknesses in internal control and correct them before they prove to be troublesome.[1]

From the above it is easy to see that it is necessary to search for an approach to two problems if overall data processing management is to be improved within the Federal Government. The first problem relates to the need for top management's coordination and analysis of the benefits provided by the use of computers. The second problem relates to the management of the data processing center itself.

The basic subject of this thesis is concerned with that operational data processing management within the Federal Government, with special emphasis directed toward the Navy Supply Systems Command of the Navy Department. Primary concern is with operational or the production phase of data processing, and not with the developmental or systems analysis phase of data processing management.

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[1]Maurice S. Newman, "Internal Controls and Data Processing," Selected Papers, 1964, (Haskins and Sells, 1964), p. 299.

RESEARCH QUESTIONS

This study is expected to provide answers to the following questions:

1. Is it possible to develop a practical integrated management information approach, for the production function of the Data Processing Center, which will both provide necessary operational control and satisfy the information requirements of higher management?

2. What are the requirements for management information by management sources external to the Data Processing Center?

3. What are the requirements for management and operational information with the Data Processing Center, in order that the production function of data processing is accomplished accurately, efficiently, economically and timely?

4. What would be the advantages of an Integrated Data Processing Management Information System for the computer center; for the activity; and for higher management?

SCOPE AND APPROACH

It is the intent of this thesis to determine, within the Federal Government, the requirements for an information and control system for the production function of data processing management; to investigate and determine the higher authority information requirements laid upon a data processing center, and to determine if it is practical to integrate the two

requirements into a single Data Processing Management Information System. With the establishment of an organization, there are procedures designed for the accomplishment of the basic mission of the organization. In order for this organization to carry out its mission, procedures are built on a foundation of effective controls. As the organization expands and the workload increases or processing procedures change, the original controls often remain in effect, or no controls are applied whatsoever. In some cases, the initial management controls may still satisfy the needs; but in many cases, the controls necessary for effective and efficient operation have become outdated.

In recent years, data processing systems have produced many management changes. Many new systems have been devised and many old systems, along with the established procedures, have changed. With the development and use of high speed random access computers, a tremendous change in the concept of accomplishing the functions of a data processing center have resulted. Along with these improved methods and procedures, there has been an increased emphasis placed on improving management efficiency of the production function of the data processing center.

It must be emphasized that the concept of efficiency is complex and must include not only elements of cost analysis, but also elements of quality, quantity, time and method. The notion that efficient management can be measured by minimum cost alone is not necessarily correct, as it applies

to the production function of data processing. It would seem that efficiency can be obtained by establishing and controlling a proper balance among the elements of quality, quantity, time, method and cost; and, maintaining this balance, even though operating in a dynamic atmosphere.

In order to accomplish the intent of this thesis, Chapter II provides the historical development of data processing management in the Federal Government. A review of the role the Bureau of the Budget plays as a coordinator for the data processing management function in the federal government is undertaken, in order to establish the important role top managements must take in data processing. It is at this point that a suggested improvement is made to the classification of information concerning computer uses. The development of this classification approach permits the collection of data processing information at the top management level which should provide a measure of the benefits received from a computer installation.

Chapter III provides an insight into the growth and development of the computer center. The main concern here is to show how the computer center developed and how this development contributed to problems of management in the computer center. Once the organization is established, it is necessary to define and determine the functions and objective for the effective operation of the computer center.

Chapter IV establishes elements for the management information system

at the computer center level. Now that the management data requirements for top management and operational management have been established, there remains only the data requirements of the Systems Command. With the addition of the information requirements of the System Command, the complete criteria have been established for an Integrated Data Processing Management Information System.

In the development of this thesis, primary reliance has been placed on library and documentary sources of material, augmented where necessary by personal interviews. The inductive method of reasoning from particular facts or expert opinion to a general conclusion will be used in answering the principal research questions. The deductive method of reasoning from an established principle to specifics was considered appropriate for limited areas.

DEFINITIONS

The following definitions are taken from Secretary of the Navy Instructions 10462-7B:[1]

1. ADP Resource Sharing: Use of any ADP resources to do work for some other organization which is not an organic part of the organization which operates the ADP facility providing the services, i.e., where customer and servicing activity do not have a common on-site superior.
2. Logistic and Business Administration Data Processing: Processing of data such as financial, personnel, inventory, supply, production

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[1]Department of the Navy, Automatic Data Processing Program, (Washington, D. C.: Government Printing Office, December, 1968), pp. A-1 thru A-3.

maintenance and program management, and generally within the scope of SEC NAV INST 5200.14 as opposed to such functions as scientific calculations, engineering design and command-control systems.

3. Planned Total Workload: The sum total (expressed as an estimate in terms of average hours per month) cited and constituted similarly to "planned initial workload," but representing the total workload as envisioned and planned at the time of equipment selection, and hence a determining factor in the relative adequacy of variously proposed equipment configurations.

4. Time Sharing: A computer operation, under the control of an executive routing incorporating a scheduling priority algorithm, which effectively enables on-line/real-time computer availability to a multitude of users virtually simultaneously. Such operations may be broadly classified as: unrestricted general purpose, restricted (or single program) general purpose, and dedicated or special purpose.

5. Data Element: The basic unit of information having a unique meaning and which has subcategories (data items) of distinct units or values.

6. Automatic Data Processing Equipment (ADPE): A machine or group of machines (input, storage, computing, control and output devices) which use electronic circuitry in the main computing element to perform arithmetic and logical operations automatically by means of an internally or externally stored program of machine instructions, and which can

operate as an independent unit in conjunction with input-output devices.

CHAPTER II

DATA PROCESSING MANAGEMENT IN THE FEDERAL GOVERNMENT

The purpose of this chapter is to review the management problems associated with automatic data processing in the Federal government; to determine if private industry has any contributions which can be applied to assist Federal government in computer management; and, to propose an approach to automatic data processing management which will provide a new dimension to budgeting and management of computer systems.

EARLY MANAGEMENT CONCERN

Early management policies regarding automatic data processing were extensions of existing policies applicable to punched card equipment, calculators and other office labor saving equipment. Management concern by the Bureau of the Budget over ADP was limited to the annual budget review process. Very little information was available outside the individual installations and agencies to indicate the kinds of equipment being used, for what purposes it was being used, the cost incurred, the systems design and programming work that was going on, the difficulties encountered, and the benefits that were being realized. The progress of change in computer development and data processing management was so dynamic that operations were becoming obsolete before they were operational.[1]

In 1958, the General Accounting Office prepared a government-wide

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[1]Ned Chapin, An Introduction to Automatic Computers, (Princeton, New Jersey: D. Van Nostrand Company, Inc., 1963), p. 201.

automatic data processing evaluation report which included the first inventory of ADP resources operated by Federal agencies. This report, along with the increasing cost of data processing equipment, prompted the Bureau of the Budget to initiate a comprehensive government-wide automatic data processing study for the Executive Branch of the government. This study recognized the need for specialized management of ADP resources, for government-wide coordination, and for accurate information for various levels of management. The action taken by the Bureau of the Budget (BOB) was to issue advisory guidelines and bulletins which covered feasibility studies, lease versus purchase evaluation, inventory reports and a sharing program.

From 1958 until 1965, various studies and reports were undertaken by Congress, the General Accounting Office (GAO) and the Bureau of the Budget (BOB). All of these reports indicated that there were needs for improvements in management, coordination and control of data processing resources (equipment and personnel) within the Federal government. It would appear that the most important problems were: (1) a lack of a government-wide automatic data processing management information system; (2) a lack of procedures for the exchange of data processing information within and between the operating agencies, (this results in considerable duplication of effort); (3) equipment acquisition procedures were inefficient; (4) a high degree of uncompatibility between systems

existed making it difficult to share automatic data processing software; (5) operating efficiency could not be evaluated since there were no standards; and (6) excessive equipment and increased cost to the government resulting from poor utilization of installed equipment.

The problems of managing automatic data processing in the government continued to grow in spite of the efforts of many government agencies. In 1965, two events occurred which had a great impact on data processing management: a Report to the President on the Management of Automatic Data Processing in the Federal Government was completed by the Bureau of the Budget which resulted in Bureau of the Budget Circular A-71; and, a statement of Congressional intent was promulgated in Public Law 89-306.

The Bureau of the Budget as the principal staff office to the President on matters of government organization and management, has overall responsibilities to conduct research in the development of improved plans for administrative management and to advise the executive departments and agencies of the government with respect to improved administrative organization and practice, will provide centralized management coordination.[1]

The Report to the President on the Management of Automatic Data Processing in the Federal Government resulted from a comprehensive study of all aspects of automatic data processing management conducted for the Bureau of the Budget by a specially appointed Advisory Committee

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[1]U. S. Bureau of the Budget, The Bureau of the Budget -- What it is --- What it does, (June, 1965), p. 5.

and Project Staff.[1] The general conclusion reached in this report was centered around a clear need to:

> strengthen the resources devoted to the management of automatic data processing within both the central agencies and the line departments.[2]

The findings in this report did not differ greatly from those revealed in the BOB study of 1959. But, in conjunction with Public Law 89-306, there was a need for action.

Congressman Jack Brooks successfully sponsored a bill providing for the efficient purchase, lease, maintenance, operation and utilization of automatic data processing equipment in the Federal government. This bill became Public Law 89-306 and developed specific responsibilities for the Bureau of the Budget, the General Services Administration, and the Department of Commerce and also identified specific responsibilities designated to the using agencies. Public Law 89-306 amended the Federal Property and Administrative Services Act of 1949, by adding a separate section of automatic data processing equipment:

> to provide for the economic and efficient purchase, lease, maintenance, operation and utilization of automatic data processing equipment by Federal departments and agencies.[3]

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[1]Bureau of the Budget, Report to the President on the Management of Automatic Data Processing in the Federal Government, (Washington, D. C.: Government Printing Office, March 4, 1965), pp. 2-4.

[2]Ibid., p. 7.

[3]U. S. Congress, A Bill to Amend Title I of the Federal Property and Administrative Services Act of 1949, Public Law 89-306, 89th Congress, 1st Session, 1965, p. 2.

EVENTS SINCE 1965

Since 1965, the Bureau of the Budget has also issued or revised a number of its circulars which enunicate the policies and guidelines that apply to ADP management in the Federal agencies. Bureau of the Budget Circular A-54, of 1961, which is concerned with the selection and acquisition of ADP equipment, was revised as follows:

1. To clarify and reaffirm its application to government cost reimbursement-type contractors;
2. New ADP equipment will not be acquired until all possibilities for sharing existing equipment or utilizing excess equipment are exhausted;
3. Requires agencies to be more specific in stating their requirements for delivery and performance of both hardware and software when executing contracts for equipment;
4. Requires the cost of money to be added to the capital investment when comparing costs in deciding whether to buy or lease equipment; and,
5. Requires displaced equipment to be reported as excess and not retained for other uses unless properly justified. [1]

Bureau of the Budget Circular A-61 reinforced the requirement for the establishment of a central automatic data processing authority at a high level within each of the departments and agencies. The purpose of this organization would be the establishment of policy and priorities, the coordination and stimulation of agency-wide systems and the promotion of

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[1] U. S. Bureau of the Budget, Policies on Selection and Acquisition of Automatic Data Processing Equipment, Circular A-54, Revised transmittal memorandum No. 1, June, 1967.

the use of time-sharing. Circular A-71, of 1965, as was discussed, established responsibilities of the General Services Administration, the Department of Commerce and the Bureau of the Budget -- basically as coordination for the executive management of ADP. Circular A-79 required a report of accomplishments in the use and management of ADP. Finally, Bureau of the Budget Circular A-83 promulgated the reporting requirements of a new Automatic Data Processing Management Information System. This Circular required all Federal agencies having organizations or data processing units, which used or planned to use ADP equipment, to report usage on a quarterly basis. Appendix A contains the data elements from the Navy implementing instruction. These data elements are considered to be directly related to the production function of data processing management and; therefore, must be considered in an integrated data processing management information system.

After numerous attempts to gain coordination and control of the management of automatic data processing in the government, the events of 1965, and those subsequent, have improved the situation. The Bureau of the Budget's Report to the President epitomized the major problems (which were similar to past problems) and made conclusive recommendations as to what actions were necessary to correct the deficiencies. Legislation in the form of Public Law 89-306, formally recognized the responsibilities associated with BOB Circular A-71.

This action settled the dispute between the General Accounting Office and the Bureau of the Budget regarding the degree of centralized control required to manage most effectively the government automatic data processing program. The General Accounting Office proposed to coordinate management of automatic data processing in the Federal government through the establishment of a small, highly placed central management office in the Executive Branch of the government.[1] On the other hand, the Bureau of the Budget considered that centralized coordination could be accomplished at department levels with specialized assistance from the Bureau of the Budget and the General Services Administration. In 1965, the President, as was recommended in the Report to the President, distributed ADP administration and management responsibilities to the Bureau of the Budget with overall supervision; the General Services Administration with selection, acquisition, utilization, standardization stuides for cost effectiveness; the Department of Commerce with consultative system design and technique services to all agencies; and, the Civil Service Commission with the executive-wide personnel management and training aspects of automatic data processing.[2]

The principal actions which have been taken to implement the provisions of the Bureau of the Budget Circular A-71 and Public Law 89-306 have essentially been limited to:

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[1] U. S. Bureau of the Budget, Report to the President, p. 5.

[2] U. S. Bureau of the Budget, Responsibilities for the Administration and Management of Automatic Data Processing Equipment, Circular A-71 dated March 6, 1965.

1. Expansion of the government-wide Automatic Data Processing Management Reporting System (Circular A-83 implementation);

2. Extension of the government-wide Automatic Data Processing equipment reutilization and sharing program by the General Services Administration; and,

3. Improved management at the agency level by stronger centralized control and coordination.

Although some impressive savings and benefits have been reported since 1965, there is still considerable room for improvement. Technology continues to progress at a rapid rate and will require even more concentration of effort if effective utilization of the computer's capabilities are to be realized. Future automatic data processing progress in the government will depend upon the expertise in management, uniformity of systems and communication, the ability to plan intelligently for the future; but, most importantly, a need by all concerned to understand and to provide for change because change is going to occur.

The past few pages have discussed the various problems involved in management and coordination of automatic data processing within the Federal government. One has read about problems of decentralization versus centralization of the management function, about purchase versus lease, about the high cost of operating an ADP installization, about a lack of management control within the data processing function and, in general,

about how poorly the Federal government has approached the utilization and management of Automatic Data Processing. This is probably the case; but, it took about fifty years before the airplane could fly at the speed of sound. The point is, the development of a new tool is now accomplished at a pace which is the end result: learning comes from experience.

WHAT HAS PRIVATE INDUSTRY TO OFFER

In contrast to what the government has accomplished in computer management, one can take a brief look at what American industry has gained from its heavy investment in computers. What has American industry learned about how to organize and manage computers that can be applied to assist government?

George Kozmetsky and Paul Kircher indicate that:

> Transition to use of electronic computers has created a number of administrative problems. The cost of the installization is substantial. Selection of proper equipment and competent personnel is not a simple matter. Experience has shown that preliminary estimates frequently are less accurate than for other type of resource allocation.
>
> Conversion of present routines, without improvement or integration, seldom results in more efficient installations. Therefore, a detailed study of the business requirements must be made. . .
>
> Presently available equipment is not always as satisfactory as some experts believe it should be. [1]

It would appear from the above that changes in progress as a result of the computer, like all changes of a magnitude, are not progressing smoothly and without problems. John Diebold has classified five distinct

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[1]George Kozmetsky and Paul Kircher, Electronic Computers and Management Control, (New York: McGraw-Hill Book Company, Inc., 1956), p. 114.

phases which have occurred during the 20 years of computer management.

1. The coldness of potential users in the early 1950's -- everyone was from Missouri and had to be shown;

2. The status "kick" of 1956 and 1957, when corporate presidents decided they had to keep up with the Joneses;

3. With the onset of the 1957 recession came disillusion as the initial installizations failed to live up to expectations;

4. Early 1960 was characterized by a growing sophistication on the part of business regarding at least the obvious data processing applications (of special importance, there was a growing appreciation by computer manufacturers of business data processing problems which affected computer design); and,

5. Today there is acceptance of the electronic computer as an everyday tool of business. [1]

An analysis of these phases of computer acceptance and utilization again serves to indicate that change is not always organized and effective. Such authorities as Herbert Willis, Maurice Newman, Robert V. Lewis and John Dearden have all discussed the problems which have beset the management of data processing in business. Perhaps two of the most noted studies, regarding the management of data processing, were accomplished by John Garrity of McKinsey and Company, Incorporated, and Robert C. Stender and Robert J. Osterhus for Booze, Allen and Hamilton. The Garrity study

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[1] John Diebold, "ADP--The Still-Sleeping Giant," Harvard Business Review, (September-October, 1964), pp. 60-61.

indicated that the major problem in getting a payout from the computer is not technical but managerial and organizational.[1] The Booze, Allen and Hamilton study concluded that computer-system success is more heavily dependent on executive leadership than on any other factor.[2] The development of large scale computer systems definitely requires the attention of top management. Successful installization of electronic data processing systems demands the definition of goals and objectives by top management and the direct and willing participation of the affected divisions or departments in determining the data processing needs.[3]

In addition to the lack of top management participation in computer management in industry, L. R. Fiock, Jr. lists the most common electronic data processing pitfalls that must be considered in management of an installization. The seven deadly dangers in EDP are:

1. Poor procurement;
2. Ignorance of procedures;
3. Service over control;
4. Middle-management resistance;
5. Inadequate staff;
6. Poor staff location; and,

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[1]John Garrity, Getting the Most out of your Computer, Special Report, McKinsey and Company, Inc., 1966, p. 15.

[2]James W. Taylor and Neal J. Dean, "Managing to Manage the Computer," Harvard Business Review, (September-October, 1966), p. 106.

[3]Richard G. Canning and Roger L. Sisson, The Management of Data Processing, (New York: John Wiley and Sons, Inc., 1967), pp. 41-55.

7. Evaluation on the bias.[1]

Frederic G. Withington states that:

> Few computer users have kept records of their total data processing expenditures in detail (indeed, they are often difficult to separate from other expenditures) and few can accurately measure the resulting benefits. Thus, few can say what their cumulative data processing investment is. Most are uncomfortable aware that they have invested much more than they initially intended; however, most will also say they feel they have obtained their money's worth: they wish they had known what they were getting into.[2]

It is easy to see that industry has experience problems similar to those experienced by the Federal government: a need to coordinate and to manage the data processing function. This is really not much of a surprise since the basic reason for the problems can be attributed to the complexity of system design and control in an atmosphere of constant change. The problem of evaluating the effectiveness of the data processing activity and exercising control over its operation remains, however. In the first place, the data processing activity is relatively new and, so management's experience with it is limited. In the second place, much of the activity is technical and, being also relatively new, most managers have only a superficial understanding of the equipment and techniques employed. As a consequence of management's inability to evaluate, and therefore control this activity, many unfortunate errors have occurred.

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[1] L. R. Fiock, Jr., "Seven Deadly Dangers in EDP," Harvard Business Review, (May-June, 1962), pp. 88-95.

[2] Frederic G. Withington, The Real Computer: Its Influence, Uses, and Effects, (Phillippines: Addison-Wesley Publishing Co., Inc., 1969), p. 163.

AN INTEGRATED MANAGEMENT APPROACH

Although certainly no final or single answer can be provided for this problem of evaluation and control in data processing management, it would appear that the Report to the President on Automatic Data Processing in the Federal Government was a start. However, along with the action to implement these recommendations, there is a need to continue to become educated concerning the changing technology, but more importantly, there is a definite need to provide management with an approach to evaluate and control data processing systems and operations.

It would appear that what is necessary is an approach to measure the contribution that the computer makes to satisfy the mission of the organization. In order to determine the accomplishments of an activity, there is usually a system of management and accounting based upon a performance budget system. Performance budgeting is predicated upon the ability to forecast with a reasonable degree of precision, the volume of work to be accomplished and the capabilities of personnel and facilities to accomplish that volume.[1] Estimates of future workload are generally expressed in terms of an assigned mission which may be broken down into specific functions. The accounting system through work measurement provides factual data on capabilities which makes it possible to estimate manpower requirements by specific functions necessary to accomplish the total mission

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[1]Jesse Burkhead, Government Budgeting, (New York: John Wiley and Sons, Inc., 1956), pp. 133-157.

and then derive the total monetary requirements to insure accomplishment of the mission. It must be noted that functions are established at the central activity in order to measure similar performance and cost at activities performing similar missions. This does cause some problems in the collection of data; but, it can be overcome without serious difficulty.

The problem of organizational structure with regard to the performance of functions and related allocation of funds within an activity is not so easily dismissed. This too can be overcome with good management and education in the proper use of functional reporting. Now the computer is added to the performance budget approach resulting in a problem which requires some change in concepts. Since the computer can perform many different functions or parts of functions at great speeds, it was not desirable to attempt to record functional data for workload performed by the computer. The computer costs, along with the personnel costs were assigned to a data processing function, which in turn was usually segregated into cost accounts or subfunctions such as ADP Analysis and Programming, ADP Operations, ADP Key Punch and ADP Clerical Operations.[1] All functions which are important in management of the organization, but not in management of the total activity mission, with regard to activity performance.

It would seem that sufficient evidence has been presented in the preceding pages which indicates that this approach is not satisfactory. What seems to be needed is a system which will integrate the measurement of work effort of

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[1]Naval Supply Systems Command, "Revised Accounting Procedures Work Measurement," April, 1968, pp. 309-311.

people to the related effort accomplished by the computer. This can be done by considering measurement of applications. Applications are defined as the highest level of interface between the functions performed at an activity and the automatic data processing effort.[1] Applications are those data processing actions which supplement the manual actions necessary to carry out a given function.

With a detail analysis of systems and subsystems related (automated and non-automated) to the missions of the activity, the integration of functions with applications could be accomplished. This approach requires that the entire spectrum of work done at an activity be included, and that each system be described as mutually exclusive from others. This does not say that effort can not flow from one system to another; but, that definite parameters must be established to define the system. With the establishment of standards, whether they are engineered, historical or a combination of both, along with the capability of pyramiding the accomplishment of effort related to standards from initial input to output through the organizational structure, it would be possible to develop total cost data for the management of the total systems including automated effort. It may appear that the above approach is over simplified; but, it seems that it can be accomplished.

The above integration of data processing applications, with the manual effort performed on function to achieve system measurement, provides a

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[1]Canning and Sisson, The Management of Data Processing, p. 119.

new dimension for management. It is now possible to measure total expenditure of all effort related to systems which relate to the activity mission. It also provides the capability to view cost data in four dimensions: system, organizational structure, system within organization, and organization within system. In each dimension, a breakdown of data processing effort is included with regard to supporting a particular organization or system. If it were possible to establish system definitions which are standard, then it would be possible to collect cost data at various activities. This cost of a system could then be analyzed with the intent of improving the most costly systems, and thereby improve effectiveness.

Carl Clewlow points out that:

> . . . high data processing equipment and operating costs make it imperative that effective budgeting and accounting be maintained for computer applications. The real problem is in defining which particular point will insure optimum application performance and at the same time provide for the necessary flexibility and control of unanticipated demands upon the computer. [1]

The above approach would satisfy this requirement.

Eric Kohler defines a comprehensive approach to budgeting as:

1. A financial plan serving as a pattern for and control over future operations;

2. Hence, any estimate of future costs; and,

3. A systematic plan for the utilization of manpower, material or other resources. [2]

Two major functions are evident from this definition. First, a plan

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[1]Carl W. Clewlow, "Data Processing in the Federal Government," The Federal Accountant, XIV, (Summer, 1965), p. 47.

[2]Andrew C. Stedry, Budget Control and Cost Behavior, (Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1959), p. 3.

which indicates the requirement of factors at some future date which serves the function of providing information for subsequent decisions and possibly influencing them. Second, a budget is a control containing criteria of cost and performance which can be compared with actual data on operations, and thereby provide evaluations toward a determination of efficiency. A budget which provides for the management of systems, as discussed above, would have the advantage of including the data processing contribution to a total system.

SUMMARY

The purpose of this chapter was to review the management problems associated with automatic data processing in the Federal government, to investigate the approach private industry applies to data processing management and to propose an approach which would provide a new dimension to budgeting and management of the computer. The problems of data processing management within the Federal government are so complex and varied that the Legislative Branch believed it necessary to provide legislation to assist the Executive Branch in controlling the cost of data processing. This legislation -- Public Law 89-306 -- formally recognized the responsibilities associated with the Bureau of the Budget. The Bureau of the Budget assumed its role as an overall coordinator of data processing management by issuing various BOB Circulars designed to implement recommendations contained in the 1965 Report to the President and Public Law 89-306. These actions

have definitely assisted the government in improving management of data processing; however, it does not appear to satisfy all needs, namely: what is management getting for its investment in computers?

An article in the December 6, 1969 issue of Business Week discusses putting the systems approach to work:

> 'The discipline of the systems approach is as important as the actual technology,' says Malcolm M. Barnum. 'In the Seventies, we are going to build up a whole new type of people -- systems engineers -- to attack problems.' The key trait of system engineers will be their ability to see a problem whole and to merge the technical disciplines needed to solve it. [1]

The Computer will be a big part of these systems and there will be an increasing need to manage the interface of manual effort and automated effort. The approach which has been proposed does offer this capability.

Mr. Walter W. Haase, Director of Management Information Systems, at the Bureau of the Budget, indicated that:

> Agencies and departments are cooperating with the Bureau of the Budget in development, establishment and maintenance of a Standard Data Processing information system (including uniform classification of programs, activities, receipt costs and expenditure, as well as other necessary standards) for budgetary and fiscal data for use in Federal government. [2]

Mr. John Pinckney, of the Bureau of the Budget, indicated that some progress has started toward improving coordination of data processing activity with the development of the Executive Branch Information System for intergovernmental interchange of information on data processing

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[1]"Human Needs Gain the Top Priority," Business Week, (December 6, 1969), p. 152.

[2]Walter W. Haase, Director of Management Information Systems, Bureau of the Budget, Presentation on June 10, 1969.

systems.[1] The indication is that the Bureau of the Budget is willing to assume a strong role as a data processing coordinator in the Federal government. The increasing number and size of the Federal programs, the complex interrelationships among today's federal programs, coupled with limited resources and economic constraints, have made the decision-making process significantly more complex. To meet these needs, the information systems which are the bases for Federal decision-making must be more closely intermeshed with the decision processes they support. For this to occur, there is a need for central coordination at the BOB level.

In a memorandum to the heads of departments and agencies, the President, in 1966, made it clear that he wanted priority emphasis on: first, using electronic computers to do a better job; and, second, managing computer activities at the lowest possible cost.[2] In the past few years, considerable effort has been focused on the accomplishment of these two objectives. But, the time has come to consider these two objectives as one, for only in this manner can it be determined that the effort applied with computer processing is, in fact, accomplishing a better job. For this to occur in the Federal government, the Bureau of the Budget must continue to take a stronger leadership role as a coordinator of systems management. Only in this manner will necessary standardization and top

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[1]John Pinckney, Staff Officer, Bureau of the Budget, Personal interview on October 6, 1969. (I was also able to interview Mr. Lawrance Slaughter, regarding more technical questions concerning budgeting for data processing.)

[2]Elmer B. Staats, "The Financial Management Scene, 1969," The Federal Accountant XVIII, (September, 1969), p. 18.

management participation be achieved.

CHAPTER III

DEVELOPMENT OF THE DATA PROCESSING COMPUTER CENTER

The purpose of this chapter is to trace the development of the data processing center concept in order to better understand the responsibilities of computer operations management with regard to processing of data for a customer. In order to accomplish this purpose, a brief review of the various stages of the accounting use of automated equipment is undertaken. Particular attention is focused on the communication needs necessary between various segments of the organization to achieve the desired results. From this review, it should be possible to relate some of the necessary requirements of computer operations management with the needs of functional management. In addition, it will be necessary to establish the internal management needs of the operations organization in order that an integrated management approach can be developed which will satisfy the objectives of the activity. Only when all the requirements of top management, and all the requirements of operational management, are known will it be possible to have an integrated data processing information system.

A GROWTH OF DATA PROCESSING

The first computer used for a business applications in the Naval Supply Systems Command was installed in 1954 at the Aviation Supply Office. In 1966, it was estimated that there were about 30,000 installed computers.[1]

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[1] David A. Woellner, "Auditing Through Computers," The Federal Accountant, Spring, 1966, p. 20.

This is a phenomenal growth that is bound to have a great impact on the business world. The computer industry continues to make improvements in the equipment capabilities. At the same time, equipment costs are being reduced which leads to even more opportunities for utilization of automated equipment.[1]

During this time, many changes have also been made in the methods and techniques of the accounting profession. Foremost among these has been the need for audits initiated by regulatory agencies: another important contributing factor has been the growth in size of the overall business. The evolution of the accounting profession has shifted emphasis from the detailed verification of transactions and balances to the appraisal of internal controls and a testing of records.[2] With the ever increasing use of the computer, the accountant is confronted with new problems in applying standard accounting techniques: this is especially true in the routing processing of data.

David A. Woellner has indicated that the automation of data processing in a business usually progresses somewhat along these phases:

> First, punched cards replace manual methods.
>
> Second, card computers, or electronic computers fed by punched cards, replace the mechanical computers in a punched card system, to overcome printer limitations.
>
> Third, tape or disc computers replace card computers to obtain greater capacity and improvements in the system of management reporting.

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[1]Richard G. Canning and Roger L. Sisson, A Manager's Guide to Computer Processing, (New York: John Wiley and Sons, Inc., 1967), p. 33.

[2]Herbert C. Willis, "The Auditor and the Computer," Selected Papers 1964, (Haskins and Sells, 1964), p. 148.

> Fourth, real-time computers replace earlier computers for updating of master records as transactions occur and the simultaneous reporting of exceptional conditions.[1]

Manual processing of data, "the good old days," occurred when a transaction was received in the Accounting Department, was processed to the necessary records, and was filed within the Accounting Department. There was no need for the accountant to be concerned with some other department losing control of the processing cycle or misplacing a transaction. Processing was accomplished under control of the accountant with close personal relationships and supporting common goals. Communications was a simple matter. If an error was detected which related to a receipt expenditure, it was an easy task to ask Jones for the details. The complete history and all related data were available for necessary analysis with easy corrective action possible. As time passed, population expanded and the business expanded. The need for less effort and shorter time periods for processing data became of concern to management and to the accountant.

The introduction of punched cards is usually undertaken to achieve cost reductions measured in terms of clerical effort and to improve reporting mechanisms either in terms of time or in terms of expression.[2] Early installations were organizationally placed in the Accounting Department, and often staffed with members of the Accounting Department, in order to take advantage of their knowledge of the accounting system. Communications remained easy and although some internal control problems existed, they

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[1]Woellner, "Auditing Through Computers," p. 21.

[2]Ibid., p. 22.

were still within the department, and could be handled without any serious difficulty.

As the use of Punched Card Accounting Machines (PCAM) was extended to additional applications within the business, the situation became more complex. Concern over application priorities, data control and flow, equipment utilization and processing schedules were requiring increasing management attention. In general, the PCAM organization remained part of the Accounting Department, but became a separate service center for the business. In the machine room, application processing teams were established which became expert in processing the various customer applications.[1] The project planner came into being as a link between the machine room and the customer of the machine room. These individuals developed the approach which was to be used in processing the application, and prepared the necessary documentation and procedures required to accomplish the desired results. Along with the respective machine room application experts, the project planner became the communications link for production processing. It must be noted that the processing cycle of a typical accounting application involved many separate operational steps. As a result, processing required considerable control and knowledge of the application. Even though a formal system of control was established in the machine room, the application supervisor was primarily concerned with processing control.

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[1]Willis, "The Auditor and the Computer," p. 150.

Now if an error were detected in the receipt expenditure processing phase, it becomes necessary to check with Jones, who probably checked with the project planner, who in turn checks with the machine room application supervisor. Once the problem area is detected, it becomes somewhat more complex to correct, but, in general, the problem will only effect the receipt application.

The transition to card computers was, in general, to achieve speedier processing and to consolidate various card processing steps. All the good and the bad of the punched card accounting machine system remained. The addition of a computer led to the replacement of the project planner by the programmer. In addition, a need for increased overall understanding of the scope of the business became apparent. There was established a definite need for the systems analyst.

The transition to tape and disc computer systems was to obtain greater capacity and a more sophisticated type of management reporting.[1] Tape and disc computer systems had a significant impact on processing procedures, reports availability, and the format in which records are maintained. It was at this point in the development of computer applications that it became clear that the processing of accounting information is only a part of the total information system of the company. The functions of production and inventory control, sales analysis, personnel records, and many more are also vital parts of the information system. According to Canning and

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[1]Woellner, "Auditing Through Computers," p. 22.

Sisson, it is at this point in the development of automated data processing that the Accounting Department should become users of a centralized data processing system.[1]

It would appear that a change of this magnitude may present some organizational strains, especially in a situation in which the PCAM has been under the Accounting Department. The accountant would now lose considerable control of the processing cycle in addition to the detailed records. Communication would now be required between separate organizations and not only with computer operations, but with the new experts: the system analyst and programmer. Application correctness, systems control and operational control would no longer be under the complete and direct management of the accountant. The detection and correction of a receipt expenditure error become very complex and involved.

This condition is especially true in the fourth phase of the automation of data processing. With total systems in real-time processing, a transaction enters the computer system directly as it occurs, and at the point at which it occurs; updating all records and triggering an immediate report of anything exceptional. Real-time operating systems represent the culmination of all prior developments in that they permit the early improvements to be utilized as events are actually happening.[2]

Computerization of accounting and financial data has revolutionized

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[1]Richard G. Canning and Robert L. Sisson, A Manager's Guide to Data Processing, (New York: John Wiley and Sons, Inc., 1967), p. 65.

[2]Woellner, "Auditing Through Computers," p. 23.

accounting and finance practices. The routine of collecting and preparing the data for reports, which was formerly a large part of the accounting job, is now accomplished by the computer, using basic source documents and initial data. Thus, the accountant has become more of an analyst, dealing with interpretation of information rather than with information preparation.[1]

In addition to making it possible for accounting and finance management to make more timely, detailed and advanced analysis of these important areas of activity, financial and accounting applications have also assisted in the development of more effective operation within the business. The extent and detail of financial information available, its diversity, and its promptness enable each manager to have a better knowledge of his operation and to apply greater information to making changes or controlling situations. At the same time, the computer can provide top management information for a more precise auditing of the same operational activity. In other words, the data can be stratified into information necessary at the various management levels of an organization. As a result, there is greater objectivity in establishing and evaluating operating standards of performance, both from an organizational and a managerial standpoint.

THE DATA PROCESSING CENTER

Now that the automation of data in an an activity has been explored, along with the development of the accounting system approach when a computer is

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[1]Robert R. Reichenback and Charles A. Tasso, Organizing for Data Processing, Special Study No. 92, American Management Association, Inc., 1968, p. 76.

made available, attention should now be turned to this new organization: the Data Processing Center. One has seen that there are basically two phases of organizational relationships as data processing expanded. The first organizational structure was oriented to the functions of Punched Card Accounting Machines. Data processing in such an organization does not accomplish centralized mechanized data handling for the total organization of which it is a part. The limitations of PCAM in terms of speed of handling data and the possibility of human and machine error, in general, prevented this. In addition, punched card accounting machinery is relatively easy to operate and the data systems are comparatively easy to develop. Users of data processing services, therefore, could readily deal directly with the data processing services application supervisor.

The advent of large computers required skilled professionals to develop data systems, operate the equipment and control the data flow path to effect economical data handling. The primary reason for the establishment of the Data Processing Center is that for the first time a capability for truly centralized mechanized data handling is available for the total activity.[1]

System planning, information management and operational integration have become very sophisticated and require extensive and detailed coordination by the potential users with the data processing department. This coordination falls into two general categories: development and production.

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[1]Woellner, "Auditing Through Computers," p. 22.

The developmental category refers to the analysis and programming efforts of the data processing center. Although the developmental phases of data processing management are not discussed in this paper, there have been many books and articles published concerning the management problems associated with implementation of new systems. The problems are especially difficult when the design is for a total integrated system.

As discussed previously, the concern of this thesis is with the coordination and management of the production function of the Data Processing Department.

Richard G. Canning and Robert L. Sisson state that:

> As in any enterprise, the function of operations is to keep things going according to schedule. In the information business, the objective is to operate the clerical and computer-based information processing so that data are gathered, manipulated, and reported according to the needs and demands of the users. The operation of an information-processing system involves all the problems of the operation of a complex, job-shoplike process involving a highly engineered product. There are problems of activity scheduling, machine utilization, and quality control (in the form of error detection and correction), as well as of incorporating the constant changes being developed by the programmer-analysts. [1]

Computer operations pertain to the actual day-to-day functioning of the centralized data processing equipment, i.e., machine scheduling, operation and maintenance. Services provided usually include keypunching, machine processing of established and developmental application programs, and preparation of output in usable form. In addition to the above operational services, there is a need to provide a work flow control to the data processing center, within the data processing center, and from the data

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[1] Canning and Sisson, A Manager's Guide to Data Processing, p. 24.

processing center.

From the above, it is easy to see that the broad objective of the data processing center is to provide data processing services which are efficient, economical, accurate and timely. There are many factors that effect the manner in which these services are provided. Among the more important factors are personal relations (within operations and between center and customers), equipment reliability, quality of output, equipment adequacy and, probably most important to the customer (if some quality is available), timeliness. The Operations Division also has responsibilities to support the Systems and Programming organization and to participate in new systems development.

Brandon has identified the functions of the Operations organization as data management, equipment operation, planning and scheduling, performance analysis, hardware and software evaluation, training and stock control.[1] There is no doubt that the above are the primary technical functions of operations; however, James Gallager has stated that a basic problem that has hindered the advance of data processing from its inception has centered around the difficulty of establishing proper lines of communications between the data processing organization and functional operations and between the various departmental groups within the data processing organization itself.[2] Therefore, it would appear necessary to add the

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[1]Dick H. Brandon, Management Standards for Data Processing, (princeton, New Jersey: D. Van Nostrand, Inc., 1963), p. 7.

[2]Donald G. Malcolm and Alan J. Rowe, Management Control Systems, (New York: John Wiley and Sons, Inc., 1960), p. 121.

function of communications to the above list. Communications may seem like a strange function (it appears to be more of a responsibility) but, unless it is considered as a function, it is likely to be second in importance to the above functions when, in fact, it is equally important. There are many documented cases where inefficiency resulted in operations as a result of poor communications. Robert G. Van Ness believes the area of communications is the single most critical problem encountered by data processing management.[1]

Recalling the earlier discussion concerning data processing growth from the accounting department to computer center, it is now easy to understand how the communication problems developed. If the value of the computer is to be realized to the fullest extent possible, there must be improvements made in the area of communication. The accountants and other data processing customers must have confidence that daily routine production is reliable, and that the data processing people are concerned about them, the customer.

SUMMARY

The purpose of this chapter was to review the stages of growth of the data processing function and to determine if the historical development of the computer center could provide any insight into requirements for improving management. As has been seen, initial data processing, in many cases, was accomplished in the Accounting Department. As more experience

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[1]Robert G. Van Ness, "Critical Problems in Data Processing," Data Processing Management Association, XI, 1966, p. 189.

was gained by data processors and equipment improved, it became apparent that it would be beneficial to establish Data Processing Departments. These departments would have the responsibility for processing all data for customers within the activity. In general, the data processing function progressed very rapidly. New positions were created in the analysis and programming fields. Often these new jobs were filled by former machine operators who had excelled. Although this approach to staffing the data processing center was filling what it considered the most critical jobs, it permitted less talented people for the operations organization. This staffing approach has caused problems in the operations organization which is just now becoming rectified.

Now that some of the problems experienced by the Government in coordinating data processing have been discussed, and the development of the computer center has been briefly traced, it is necessary to progress to the more detailed management needs of the data processing center.

CHAPTER IV

MANAGEMENT NEEDS OF OPERATIONS

INTRODUCTION

To accomplish the objectives of the Operations organization, which in turn must support the requirements of the previously discussed functions, the development of a control and information system for operations management is essential.[1] This system must provide the means for bringing to each level of management, internal and external to operations, the necessary and complete information that is accurate, timely and sufficient so that the manager can fulfill his responsibilities. Such information must flow to operations, within operations and from operations. It must be based on sound data in a flexible system but operate at a reasonable cost commensurate with information provided.

Before continuing with the requirements for an information system for operations management, which is the purpose of this chapter, it is necessary to take another look at what Roger L. Sisson and Richard G. Canning have to say about the operations function of data processing:

> As in any enterprise, the function of operations is to keep things going according to schedule. In the information business, the objective is to operate the clerical and computer-based information processing so that data are gathered, manipulated, and reported according to the needs and demands of the users. The operation of an information-processing system involves all the problems of the operation of any complex, job shoplike process involving a highly engineered product. There are problems of activity scheduling, machine utilization and quality control (in the form of error detection and correction), as well as of incorporating the constant changes being developed by the

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[1]Many of the control and management concepts discussed in this chapter were developed and implemented at the Naval Supply Center, Pearl Harbor, Hawaii; during which time the author was assigned as Director of Data Processing for the activity. See Appendix B for more information.

programmer-analysts.

The major difference between the operation of an information system and that of other business involve two factors:

1. Information systems are "invisible" in nature. The managers of the information-processing operations must keep track of a wide variety of activities which are difficult to observe directly. Therefore, careful reporting is required to insure that all parts of the system are operating properly. Fortunately, the computer itself can be used to assist materially in the control of the data-processing operations.

2. The information-processing business is often decentralized throughout the company. Data recording occurs at the line operations and in the field in conjunction with sales, as well as in various other parts of the company and at its customer's and vendor's plants. Communications brings together these data through a decentralized network. Processing is often done at many points -- branch offices, plants, corporate headquarters, and so forth. The managers of the data processing operations therefore must handle an operation which is integrated in the sense that the information flows throughout a connected system, and yet is organizationally and geographically spread out.

In general, however, most standard management practices apply to the good operation of a data-processing function. [1]

Although the above comments were directly concerned with private industry, they also apply to government managed activities. The main concern, and the continuing responsibility, of the Data Processing Center is to strive for the best possible economic results from the resources currently available. The Data Processing Manager has many systematic and scientific techniques which can be employed during the planning and control of the operation. There is a need to:

1. Formalize the objectives of the overall operation and set policies to

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[1] Canning and Sisson, A Manager's Guide to Data Processing, p. 24.

be followed in their attainment.

2. Establish a plan of action to achieve program objectives.

3. Install necessary controls insuring efficient operation.

Good management does not come by accident. It must be planned systematically. The operations manager of a data processing center must know the basics of management first, and the technicalities of computers second. Knowing the details of binary numbers will not help the manager in rescheduling around a magnetic tape unit that is dropping bits, or otherwise failing to operate reliably. The computer manager's main job is the production of reports and maintaining the data for the user elements, by using the resources of computer facility to the greatest advantage. It is important to know and to understand the type of work problems that occur and the best way to cope with them. The best way to accomplish this task is through effective planning and control of the operations.

MANAGEMENT APPROACH

A management device or technique, regardless of the degree of sophistication, is only a tool and can never be a substitute for effective managers. These techniques and tools must be an integral part of the whole management process. Therefore, logically it is necessary to establish a sound concept of the management approach. The management approach is the result of evolution over many generations of trial and error. Much has been written about the function, environment and the role of management.

The function of management entails the continuous, intelligent direction of others by determining and communicating the prime and supporting objectives of an organization.[1] This function necessarily includes the development and utilization of an integrated time-phased plan of action, demanding reasonable requirements in the way of resources and the subsequent balancing of resources as they are made available and used.

To develop and understand all these factors in operation better, it is necessary to take a brief look at the basic steps in the cycle of applied effort:

1. The determination and effective communications of the prime and supporting objectives;
2. The development of a coordinated plan of action for the accomplishment of the objectives;
3. The conversion of the plan into integrated schedules within available resources;
4. The regular reporting and concurrent evaluation of progress against the scheduled plan and cost estimates;
5. The recycling of the above process to achieve the incorporation of a desired new action into a new cohesive scheduled plan.[2]

The determination and specification of objectives are the initial and most important phases in the management approach, largely because the objectives of an organization are its main reason for existence. The objectives of the Operations organization were briefly discussed in the last chapter. All

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[1]Kozmetsky and Kircher, Electronic Computers and Management Control, pp. 139-141.

[2]Ibid., p. 159.

organized activity must have as its motivating and guiding force the attainment of some predetermined objectives. The current purposes of the organization must be the yardstick, against which all requirements and accomplishments are measured and evaluated.[1] The progressive passing down of specific coordinated objectives from higher to lower levels of management sets the target for and the authorization of detailed planning effort on the part of the receiving organization.

Once the objectives have been established and agreed upon, the next phase is the development of a plan to satisfy the objective. The planning function sets forth the nature, sequence and interrelationships of the supporting objectives which must be accomplished to achieve the main objective.[2] Planning is primarly concerned with the structuring and relationships of units of required effort. It establishes the feasibility of meeting the directed due date for the successful attainment of the objective. The plan must be realistic in its requirements and consistent with the available resources and time element. The planning function at each level sets forth the important objectives of the kind, quality and quantity for the work to be performed. If this planning phase is not accomplished, there will be no assurance of a coordinated, balanced use of resources. Initial planning considers the required resources, including elapsed time, and should to a limited extent consider the competition for these resources.[3]

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[1]Brandon, Management Standards for Data Processing, p. 7.

[2]Kozmetsky and Kircher, Electronic Computers and Management Control, pp. 139-145.

[3]Ibid., p. 157.

Scheduling is the bridge from the planning stage to coordinated, effective implementation.[1] It is the translation of the plan, with its elapsed time estimates, into calendar time. The scheduling function considers the competition for available resources both within and between programs. If the earliest attainable scheduled completion date of the current plan is later than the desired date, there is a need to review the original plan and make any necessary adjustments. The goal of the scheduling phase is to produce a calendar time-phased plan consistent with desired completion dates for the assigned objectives. This schedule is the vehicle for authorizing effort and resources to be expended. It serves as a basis for the continuous evaluation of progress.

Once the scheduled plan has been activated, a formal procedure for the regular reporting of progress against the scheduled plan is necessary. A process for the early detection and specific description of a potentially significant problem area, while there is still time for management to seek solutions to that problem, is required. The management approach emphasizes, therefore:

1. Regular, continuous evaluation of actual performance against current scheduled plans; and,

2. Detection and isolation of significant deviations from the scheduled plan as a forecast of time and cost overrun.[2]

The principle of "significant feedback" effects a great reduction in the

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[1]Ibid., p. 158.

[2]Ibid., p. 160.

volume of statistical reports. By considering only the significant deviations from the scheduled plan, the manager need only obtain a detailed analysis of the specific problem covering: what remedial action is being taken and by whom? what results may be expected and when?

The magnitude and relationships of all desired changes must first be reviewed in the light of their effect on the scheduled plan. Changes may be caused from alterations in prime objectives or isolation of the problems at any level of effort. The point of origin of the changes is not as important as the orderly method of authoritative approval and implementation. Deviations from the scheduled plan may require only a change in schedule. By concentrating on the most important current or forecasted problems, management can expend its effort to achieve the maximum potential returns relative to the assigned objectives.

The incorporation of change is achieved by a recycling of the management approach to provide a revised scheduled plan. Dynamic recycling is the method of achieving and maintaining management control of objective-oriented effort. The formal progress, reviews and evaluation meetings held by management with their supporting managers provide an opportunity to accomplish the mechanics of the recycling process.

The last few pages have described the management approach. It is this management approach which must be applied by the operations manager of a computer center. One is now concerned with specific areas which a computer center manager will encounter in his daily activities.

COMPUTER CENTER ACTIVITIES

Much of the information for this section was obtained from two basic sources: Brandon's Applied Systems, Inc. Operations Management Course and the Department of Defense, Computer Installization Management Seminar.[1]

Organization of the operation's function is important to the approach which the manager will employ in the accomplishment of objectives. For this reason, a brief discussion on organization follows. Brandon suggests that the Operations organization be divided into three subsections: Planning and Scheduling, Data Management and Machine Operations.

The Planning and Scheduling subsection should, in addition to the scheduling and production planning functions, include the responsibility for operations documentation and control of new operational programs. This subsection is the key which will cause the Operations organization to be responsive to customer needs. It would seem that every large customer should have a production scheduler who is concerned about getting the productive effort for that customer completed. If the customer has many applications, it may also be necessary to segregate workload, within the Planning and Scheduling Section, by application. This approach provides the Operations organization with the capability to specialize in specific applications; and will result in improved processing. These application specialists should also control the documentation for the application.

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[1]Many of the management techniques and concepts discussed in these courses were incorporated into the Naval Supply Center, Pearl Harbor system. The concepts provided in this section were the foundation for the NSC, Pearl Harbor system.

The Data Management subsection is responsible for the input control, output control and operations library in the approach recommended by Brandon.[1] This approach is satisfactory but requires considerable coordination with the Planning and Scheduling section. If the concept of customer and application management were to be extended to include input and output control, and the management of the tape files, it would be possible to consult with a specialist who has total responsibility for an application. The concept has probably progressed from an individual to an application team. The important point is that the manager has someone who is concerned about a specific application. In addition, if the concept to total application management is used as discussed in other parts of this thesis, considerable coordination can now be achieved within the data processing organization.

The Machine Operations subsection has the machine operators. This is the organization which accomplishes the data processing. This subsection usually includes a Data Preparation activity, the Electronic Accounting Machines activity and the Computer activity.

The environment of the computer center includes the physical space occupied by the computer equipment configuration, the magnetic tape library, supply storage areas, and the air-conditioning, humidity and dust control equipment. Environment standards (which pertain to air-conditioning, humidity, dust and electrical requirements for the computer equipment configuration) are established by the manufacturer. The physical layout

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[1]Brandon, Management Standards for Data Processing, p. 165.

of data processing equipment should be considered as important as the layout of a factory assembly line. The physical layout will govern the effective flow of work from raw data input sources and the magnetic tape library and the card and paper supply storage areas; to the processing areas, and the distribution of finished products.

Any environment standard may be established for the flow of work through the data processing operational area, with pre-designated waiting areas for data to be processed; accompanied by the necessary input and documentation or instructions to the operators, as well as pre-designated receiving areas for the completed work. Standard flow should be established and controlled to avoid congestion in and around the equipment. The pattern of layout for the most efficient operation of large volumes of programs will require the placing of equipment, in relation to the tasks assigned the console operator and other operations personnel.

The maintenance of the tape library is performed by the tape librarian. Instructions pertaining to the programs to be run, to the program sequence and the data tapes/cards, and to reference files, are contained on the various production programs. The tape librarian is responsible for: maintaining the program documentation in program number sequence; assembling the program documentation in the sequence specified on the daily schedule; assembling the input data and tape files in the sequence specified in the daily schedule; and recording the real numbers of scratch tapes on the daily

schedule. Tape personnel are responsible for completing and attaching external tape labels to the reels. The tape librarian is also responsible for maintaining the records for each reel of tape by identifying the program used to generate the data file and other pertinent data as to dates of updating and purge dates.

Maintenance of all equipment should be scheduled on a regular basis. The amount of time recommended by the equipment manufacture for preventive maintenance should be used as the basis of scheduling. An analysis of the time spent in scheduled maintenance, and the reliability of the equipment with varying amounts of maintenance, will establish a minimum and maximum acceptable level for routine maintenance. This analysis should include the data collected on machine failures by the type of failure for each unit. Very often this type of information is only available from an equipment engineer. Exceeding the maximum acceptable level of maintenance indicates replacement of the particular units that may be required. Maintenance performance less than the minimum acceptable level should be examined for cause; for example, maintenance not scheduled or performed because of production requirements. This condition may indicate the need for additional equipment or faster equipment.

The management of operating supplies should be the responsibility of the Operations organization. The responsibility for the maintenance of operating supplies should include maintaining a detailed record of supplies

on order, on hand, current usage, economic lot size, minimum order quantities and available space for storage. The individual assigned these duties should also be responsible for maintaining the supply levels in the computer room on a daily basis, and for returning excess supplies to the stock room. The establishment of inventory levels for cards, paper in various multiple parts, printed report forms, etc. should be based upon initial estimates provided by Systems. A continuous analysis of actual volumes consumed on regular processing cycles should be made to adjust inventory levels to the minimum normal required. An analysis by application would be advantageous as a means of informing the user, and for predictions of increasing or decreasing supply requirements. Standard inventory control and recording procedures should be established and enforced. Surplus supplies should be turned into normal supply channels for use by other activities, when quantities on hand justify the expense of handling.

The major concern in the operation of a data-processing center is scheduling. The problem arises because of variability in the demands upon the equipment, and the variability in equipment's capability to meet the demands. Ned Chapin has made some of these observations about schedules:

> In the first place, the length of jobs tends to vary, for several reasons:
>
> 1. An application done one time will not take the same amount of time when done again because of variation in the input.

2. The time at which customers want their jobs done tend to be concentrated in certain parts of the fiscal cycle.

3. The amount and type of equipment which can be used to do the handling are limited because of the cost of the equipment. If equipment were free, a lot more of it would be used in order to avoid the scheduling problem.

4. The equipment is subject to malfunction from time to time, and this makes the exact availability of time on the equipment very unpredictable except in terms of averages. [1]

There are three basic steps in establishing a loading and a scheduling system:

1. The selection of the unit of measure for the work to be accomplished. In most computer operations, machine-time is used as a measure since this is the most natural to the activity.

2. The selection of the facilities or operations to be controlled. A good general rule is to control only those facilities in which the cost of control can be clearly justified. These facilities must offer sufficient savings in time and money to warrant the cost of formal control. In some data processing operations, because of the interrelationships of various work centers and the need to having input available on time, it becomes necessary to control the specific operational steps in the processing cycle. In addition, in some operations, the lack of a scheduling system becomes apparent when operations are informally controlled, because ample processing capacity is provided.

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[1] Ned Chapin, An Introduction to Automatic Computers, (Princeton, New Jersey: D. Van Norstrad, Inc., 1963), p. 375.

3. The selection of the type of loading and scheduling technique to be used. An analysis of computer operations reveals that two types of scheduling and loading techniques are in general use; primarily run scheduling or scheduling by shift. The scheduling by computer run is the most elaborate method, and there should never be a question about what is expected of each data processing work center. It is possible to estimate the earliest possible completion time of any run, with assurance to the customer that delivery can be met. For each individual operation step within the processing cycle, the set-up time, start time, completion time, and, in many cases, data coordination time must be specified. Before order scheduling can be successfully applied to computer operations, it is necessary to have a well developed program for setting accurate time standards, and to have an adequate system for communications.

In discussing scheduling of computer operations, it becomes apparent that some of the other production control functions are highly interrelated with scheduling computer operations. For instance, realistic scheduling is very dependent on routing of work. Dispatching of work is dependent on planning and reporting. It is important for the manager of a data processing center to have identified these various functions, and to be able to assign responsibility for management of the function.

The subject of scheduling the general purpose computer has always been a difficult problem for the computer center manager. Every customer wants

faster turn-around time. Some jobs, particularly the day-to-day data processing jobs, have fixed schedules. Compilation, test shots, etc., are typically on a first-come first-served basis, usually with some over-riding priority system.

The total workload has a decided bearing on the speed of service. Since high load usually means lower unit costs, but longer turn-around time, these conflicting incentives can provide interesting problems for the computer center manager. The computer charge rate has a habit of becoming the most well-known piece of information about the computer, especially if it is a large computer system, and the rate is correspondingly large. Developing techniques to get the work done faster on the computer will result in decreased costs; thereby reducing the rate. Computers and peripheral equipment are devices that run at a fixed rate of speed; therefore, the techniques to get the work done faster are generally new setup, scheduling and handling techniques.

To gain perspective and to back away from the "microsecond mumbo-jumbo" that frequently surrounds computing on data processing, it is advantageous to consider the system as a piece of productive machinery. First, it should be recognized that the computer system is probably its own best customer. About 25 percent of the usable time of a data processing system is consumed by assembling, compiling, program checkout, sort, etc., or get ready type work, in order to keep the system operating smoothly.

Several exhaustive studies have been made on this get ready phase. Unfortunately, the results show that on an average, the system and/or any of its components are actually in use only 75 percent of the elapsed time; that is, between pressing the start button and the end-of-the-job halt. If one adds another 10 to 15 percent in time for setup, these areas of actual operational techniques, and the inefficiency of use of an expensive piece of equipment, may well be fertile areas for cutting through methods improvement and better scheduling.

All time-recording systems require the operator record time and identifying information for programs run in varying degrees; therefore, the operator can still be considered the pivotal point for maintaining time records by use categories. Operators require specific instructions in the maintenance of logs, as well as constant supervision to assure adequate control. Meters provide an accurate accounting of productive use time, but are less advantageous than the addressable memory clock. This approach requires the reading and recording of elapsed times for each piece of equipment, following a program run for an accurate determination of use time and associated costs by program, job and/or customer. This method is an accurate economical method for determining total rental due.

Effective time reporting is essential; and it provides the means for positive management control. Progress reporting, which measures overall efficiency from overall performance, gives a positive indication on the status

of any project, program, or scheduled item. Since utilization will be the key to any successful scheduling or evaluation system, it is necessary to establish a procedure which can lead to a standard against which day-to-day machine utilization can be accumulated. It is important to note that this figure is not oriented to cost measurement initially. Cost measurement will follow as one accumulates machine time utilization as a summary figure from equipment meters, and then analyzes utilization to determine if machine utilization percentage is within satisfactory limits.

There are usually several categories for which machine time is recorded; but it is necessary to consider only two of these categories for the purpose of determining percentage of utilization. From previous discussions, it was indicated that about 25 percent of total equipment time was used for other than production. Since production is now of concern, the first figure which is to be evaluated is the time for which leased costs are paid, for example, the metered time. This will represent the total time which is available for production. The other significant category is time during which actual, useful production is accomplished.

It is important to note that the computer center is absorbing the costs, when the meter is operating, and re-run time is necessary. This area is the real problem in determining effective utilization of computers and supporting equipment. Many occasions have resulted when necessary re-runs are identified as valid and useful production time; but, in fact, the

previous processing, which was incorrect and which made the rerun necessary, is also counted as productive time. Machine time utilization cannot be properly shown nor can utilization be properly computed unless a system of utilization recording is understood by all members of the data processing center.

Utilization recording is the single most important information collected for data processing management. It is essential that this data be accurate and therefore, there is a need to establish a reliable quality control procedure to insure the accuracy of this data. Remember, utilization data serves as the basic input into the costing system, and also into the scheduling system.

Although emergency situations may be expected very infrequently, it is nonetheless advisable to prepare against the possibility that the system will be inoperative for some period of time.

Provision for emergency procedures must be tailored to the specific installation's needs. In general, the backup procedure need not be elaborate. Workable procedures must exist, however. Procedures may consist of working arrangements with another installation having a compatible data processing system; or it may consist of alternative manual procedures. Included in the plans for backup procedures should be a time element for delay, that is, the plan should specify how long the system can be inoperative before the emergency procedure must be implemented.

Before taking a brief look at the budgeting and costing of operations management, a few comments are required about the console operation. Responsibility for operations at the data processing system console should be assigned to a console operator. In addition to complete familiarity with the computer system, console operators must be familiar with the various production programs. This knowledge can be obtained from application flow charts, and from the program manuals which provide the basic logic of a program.

The console operator is normally responsible for insuring that all necessary input is available for a run. The operator must be fully aware of what the output of the various programs will be, and also of its disposition. This is especially important if the computer system operates in interrupt mode, and exceptions are generated by an on-line card punch unit.

In addition to console operation, the console operator has the responsibilities for record keeping, checking tape labels, running program tests and other type duties. This record keeping includes the maintenance of a continuous operating/utilization record which includes such data as: which programs are run, when started (both clock time and meter time are important), when finished, which tape drives are used, which other auxiliary equipment is used, etc. As indicated in the discussion on utilization, records on equipment and personnel usage are required for determining lease charges, and charges to various line departments for costs involved

in processing a specific application. For this type of costing system there is, of course, a considerable data collection requirement. The question which often is open for discussion is the value versus the cost. This is the subject of the next few pages.

According to John Dearden:

> Budgeting and accounting for the data processing activity presents several unique problems. Because these problems always occur, management should have some understanding of them.
>
> The data processing activity can be divided into three parts for purposes of budgetary control:
>
> 1. The administrative organization
>
> 2. Data processing implementation
>
> 3. Processing
>
> The first is an administrative activity and can be treated as such in a budgetary and accounting system. . .
>
> Activities 2 and 3, however, are not administrative. They provide services for both line and staff operations at the request of these activities. As a result, the level of activity performed by the data processing group is partially outside of its control; it is subject to the demand for its services. This fact presents a number of problems:
>
> 1. The data processing group cannot develop budgets or make forward plans without coordinating these plans with departments likely to use its services.
>
> 2. In approving the budget of the data processing group, the authorization for the work performed for other departments may be obtained from:
>
> a. The management group that approves the budget, or
>
> b. The department that is to use the service.

> This brings up the problem of charging the cost of data processing to those who use it. . . When possible, it would appear that each operation should pay for the services that are rendered to it. If there is no charge, there is no incentive to keep the demands for service consistent with the value of that service to the user.[1]

Currently, this approach is not used in the Naval Supply Systems Command. In general, a data processing budget is divided into three areas: equipment costs, labor costs and supplies. With the use of Resources Management System by the Navy, the data processing costs have been divided into:

1. ADP Analysis and Programming
2. ADP Operations
3. ADP Keypunch Operations
4. ADP Clerical Operations[2]

This information does not appear to be sufficient, for a manager must know what portions of his operations lend direct support to the organizations to which service is provided, and what portions rightfully are chargeable to the data processing operation. Accordingly, it becomes necessary to develop a system to properly allocate the costs of operation on an equitable basis, and in proportions to the usage or benefits derived. Many centers include satellite computers or other peripheral equipment, therefore, the development of a cost accounting and allocation system requires a considerable amount of analysis. There is the need for a cost accounting and allocation system for effective management of the data processing

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[1]John Dearden, Computer in Business Management, (Homewood, Illinois, Dow Jones -- Irwin, Inc., 1966), p. 177.

[2]Naval Supply Systems Command, "Revised Accounting Procedures Work Measurement," April, 1968, p. 5-309-311.

activity. It is equally important for the using organizations to have service cost figures available for their use in improving planning. In addition, one has seen the need for a strong data processing control approach which must include elements of scheduling and workload distribution control. If it were possible to integrate all the data processing management needs into a single system, considerable effort and confusion would be reduced. Just such a system is discussed in the next section of this thesis.

AN INTEGRATED MANAGEMENT SYSTEM

The entire system must include various subsystems designed to accomplish specific needs of Operations.[1] These subsystems relate directly to the functions established by Brandon.[2] In addition, the overall management system must provide coordination and management control to satisfy the communication needs of the customer and the data center. The total Operations Management System is broken down into the following subsystems:

1. Data Management Subsystem
2. Equipment Operations Subsystem
3. Planning and Scheduling Subsystem
4. Performance Analysis Subsystem
5. Hardware and Software Subsystem
6. Stock Control Subsystem[3]

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[1]For more details see Appendix B.

[2]Brandon, Management Standards for Data Processing, p. 7.

[3]Brandon, "Computer Operations Management and Control," pp. 6-9.

It is not the intent of this thesis to discuss the detailed specification of each subsystem since this would require considerable time and space. Appendix B contains an approach to an operational system. The important point is that these subsystems are essential in effective computer room management. A brief statement of the general content of each subsystem is necessary, however, in order that an understanding of the overall co-ordination can be seen as essential to an effective operations management system. Although the subsystems identified by Brandon are used to identify major breakdowns for the entire system, the general content of each subsystem is based upon the Naval Supply Center, Pearl Harbor integrated system.[1]

The Equipment Operations Subsystem is concerned with collection of utilization data and the necessary staffing of operations equipment. The Performance Analysis Subsystem is concerned with evaluation of total operation performance against standards. This subsystem is also concerned with changing patterns of workload, keypunch performance against standards, evaluation of output with regard to schedule, and various other management goals. The Hardware and Software Evaluation Subsystem is concerned with the effectiveness and efficiency of computer operation and program operation. The Stock Control Subsystem is concerned with the management of supplies used by operations in preparing output.

The Data Management and the Planning and Scheduling Subsystems are

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[1]Brandon does not identify these concepts as subsystem for an integrated data processing management system, but as functions to be performed by Operations Management.

closely related. The management of these two subsystems should be established within one organization component, such as, the Data Management subsection. The Data Management Subsystem includes the documentation needs of Operations; the work-flow controls to, from and within Operations; the inventory of all output products; and management and security of all data files. This subsystem must also include all administration of the Operations Management System.

The Planning and Scheduling Subsystem is concerned with both long-range and short-range planning. Scheduling is a specific type of planning function and can be divided into two basic types, i.e., planning and operational scheduling. The planning schedule would include a monthly schedule of production operations indicating by job code, and by customer, the cut-off for input, and the scheduled completion data of output. The Operational Schedule is used by Operations to schedule daily production.

The above concepts are found in most data processing centers, however, the integration of these subsystems is often lacking. In order to integrate these subsystems, it is necessary to develop an identification code for each production job. This identification code is used to identify a specific set of job steps, computer program runs, accounting machine operations, and other operating instructions, with a specific data processing customer, and a specific input and output.

The basic source data for the Operations Management System are

contained in a magnetic tape file of all job codes for all production runs accomplished by the data processing center. The file is in sequence by job code; and it includes in the master record job steps, such things as due-in and due-out dates (either calendar or workday within a month), and a control code. Each job code contains job step trailer records, which are in sequence for completion of the job. These job steps indicate the order in which the job is to be completed, the equipment on which the job is to be run, the run number, and the average run time required to accomplish that computer or machine run.

All documentation and related paper work contain this identifying job code. The inventory of data processing output contains this job code. All equipment and manpower utilization is job code oriented. Utilization of manpower and equipment is broken down to provide costs by customer and application -- again job code oriented. Data processing tape files are controlled by job code and run number. A monthly planning schedule is provided the customer which indicates due-into and due-out-of the data processing department; and again it is job code oriented.

The important point is that there has been established an identification code which is common to all factors of production for a specific job. This code is utilized by both the data processing customer and also the data processing operation when discussing any problems relating to input, output, quality or production. Performance and cost evaluations are

related to specific jobs, and can be developed for each job step as well as the entire application. Internal control is greatly increased since each production step is provided and controlled. Scheduling is much more efficient since workload running times are available for each job step and the various stages of job completion can easily be determined.

T. J. Smith recognized the importance of an operations management system along with a responsible organization within the Operations Division to function as data managers when he wrote:

> It is the function or responsibility of the data control center to maintain all controls applicable to both the physical and machine movement of data. The importance of this function cannot be over-emphasized. The economic factors which virtually dictate utilization of equipment on a 24 hour day, 7 days a week basis generally result in the running of many systems or portions of systems during second and third shift periods with only skeletal staffs. A strong data control center is a mandatory requirement for effective coordination and control of three shift operations. Failure to meet scheduled deliveries of outputs, delivery of inaccurate or incomplete reports and excessive operating costs resulting from re-running erroneously processed data can usually be attributed directly to the lack of a strong data control center.
>
> Working from the externally established controls, the data control center should:
>
> 1. Develop corollary and complimentary records which will:
>
> a. Trace the physical movement of physical data from operation to operation, and
>
> b. Trace the machine movement of converted data from program to program and from machine to machine.
>
> 2. Develop methods of verifying the accuracy and agreement of the data as it is processed from program to program and machine to machine.

3. Perform the verification procedures continuously on all data processed, including acknowledgement of verification procedures by supervisory signature approval at appropriate points in the verification process.

4. Define, direct and control machine operations by:

a. Scheduling and releasing the source data to perations for processing;

b. Verifying return of the source data from operations when processing is completed;

c. Verifying return of output data, records, and reports from operations when processing is completed;

d. Maintaining records of output users and verifying delivery of outputs to the users;

e. Maintaining current and complete documentation records of machine programs and operations;

f. Releasing programmed computer instructions to operations only when needed to process current data;

g. Releasing punched card files and magnetic tape files to operations only when needed to process current data;

h. Indexing, labeling and storing all card files, and programmed instructions in a secured library facility; and,

i. Developing and maintaining retention schedules for tape and card files, and releasing of tapes for re-use or destroying the card files at the end of the retention period. [1]

It is easy to see how the Operations Management System discussed above can greatly assist the fulfillment of functions outlined by Smith. Without the job code identification, it would be almost impossible to accomplish the control called for by Smith. The Operations Management System does provide a means to relate various processing steps to a

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[1] T. J. Smith, "Controls for Verification and Distribution of Reports," Data Processing Management Association, Vol. XI, 1966, p. 286.

larger process or output, and thereby improve management control.

Efficiency of operation also depends on the "production mindedness" of the personnel charged with the day-to-day operation of the machine room.[1] When Operations personnel realize that the computer is basically a machine designed to process data and hence operate it and manage it to process data, the objectives of the Operations Division will be accomplished without difficulty. This attitude is greatly enhanced by the Operations Management System, since the importance of production mindedness is recognized in all phases of data handling. Of particular importance is the approach to improve communications. The customer is provided with a planning schedule which can be used to coordinate his (the customer) workload requirements. A total planning picture is thus available to both Operations and to the customer.

Alan J. Rowe has indicated that there are three C's in control essential to a control system. The first is confidence -- the confidence of people working in an appropriate environment. The second is the capability of the individual -- he has to be able to relate his own asperations and his own needs to the goals of the company so that he can make a commitment. And the third is communications -- the ability of management to provide feedback to individuals on what is being done so that they know what action is required.[2]

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[1]Ned Chapin, An Introduction to Automatic Computers, (Princeton, New Jersey: D. Van Nostrand, Inc., 1963), p. 365.

[2]Alan J. Rowe, "Coming to Terms with Computer Management Systems," Financial Executive, April, 1968, p. 65.

With the increasing reliance by management on business information systems and the increasing complexity of these systems, the need for strong document and accounting controls is even more apparent. Boore and Murphy have indicated that management has been finding out that it has been running the business primarily on custom, tradition, guesses and intuitive hunches.[1] A more comprehensive review of how the organization really operates, when coupled with the computer-based information system's capability to manipulate information and provide accurate and timely information, can significantly improve the quality of decision making and the effectiveness of the organization. In this management approach, the data processing center plays an ever increasing role. As this important function expands, there is a need for the Operations Management to apply the three C's of control: confidence, capability and communications.

Recalling the requirement to collect data processing costs for top management along application lines, one can now see that it is possible, and also desirable from the standpoint of the computer manager. In most cases, the job code can be used to identify the application, and thereby provide the base for collection of utilization and cost data. With this approach, it is possible to determine such information as total application cost; cost broken down by labor type and equipment. For example, it would be possible to determine the total data processing costs for the payroll application. These costs could be broken down into labor types and

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[1]William F. Boore and Jerry R. Murphy, The Computer Sampler, (New York: McGraw-Hill, Inc., 1968), p. 202.

equipment types. A further breakdown could be provided which would indicate the time required for processing a payroll through keypunch, to EAM, card to tape edit, to payroll computation, and to preparation of the checks. Total elapsed time could be provided in addition to the total processing time by each operation step. The important point is that a management tool has been developed which permits improved service to the customer, as well as providing an actual cost and utilization amount for the services received.

SUMMARY

The purpose of this chapter was to review and establish the management functions necessary for efficient computer center operation. With the improvement in data processing equipment, the processing of data by the data center expanded throughout the organization. As a result, many functional applications were transferred to the computer, with more and more functional managers dependent upon the data processing center. It soon became apparent that separate applications made use of common data, and that considerable benefits could be achieved from the development of a management information system. The increased emphasis on management of the business was not (in many cases) carried into the management of the data processing center.

In order for the data processing center to satisfy the basic objectives of efficient, economical, accurate and timely production for its various

customers, it is essential that Operations management support the functions identified by Dick Brandon.[1] An operations management system, which provides the capability of integrating the various requirements of each of these functions with the needs of the customer, will greatly assist the successful operation of the data processing center. The job code identification concept has been suggested as the means to accomplish the necessary integration.

With the establishment of a responsible group of people concerned with the control and management of the data within Operations, and fortified with information from the operations management system to improve their capabilities, it would be possible to improve the communications between organizations, and thereby to develop confidence in the Operations organization. Service to the customer can best be provided when the Operations organization is production-oriented, and is provided the tools required for effective management.

It must be concluded that there is little difference between administering a data processing activity, and managing any other operating department. The same basic management functions must be understood and applied properly. The manager must have an intimate knowledge of his tools (their benefits and their shortcomings) and must know how to use them. He must realize that he is working with a new technology which may be foreign to some of his contemporaries and, accordingly, subject to a

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[1]Brandon, "Computer Operations Management and Control," pp. 6-9.

certain degree of skepticism or mistrust.

Perhaps the most significant difference in managing a data processing operation is one of concept. The new management technology -- the information system concept -- originated with and is dependent upon the data processing activity. A decade ago, the computer was used primarily as a tool to process large amounts of data rapidly. It advanced forward with the application of statistical and mathematical methods to decision-making problems, utilizing techniques like mathematical programming and methodologies like operations research. Today the computer-based information system is accepted as a necessary tool for management at all levels. The efficient operation of a system is the responsibility of data processing management.

CHAPTER V

CONCLUSIONS

The first duty, and the continuing responsibility of the business manager is to strive for the resources currently employed or available, wrote Peter F. Drucker.[1]

Today the manager of the data processing operation has tools at his disposal which have improved phenomenally in the past few years. Unfortunately, these tools have not always been used to obtain the best economic results. In fact, it has been learned that data processing is not paying its way in a large number of installations.

Most important, among the several factors contributing to the success or failure of the data center, is the manager of a data processing operation and his ability to direct this information potential most beneficially. There is a need for the manager to understand and apply basic management functions to the operations. He must:

1. Formalize the objectives of the overall production operation and set the policies to be followed in their attainment.
2. Establish a plan of action to achieve the stated objectives.
3. Develop and install necessary controls to insure efficient operation.[2]

The central objective of the data processing system should be to provide management with the information required to institute executive action and evaluate the results of such action. To accomplish this, the

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[1]Peter F. Drucker, "Managing for Business Effectiveness," Harvard Business Review, May-June, 1963, p. 53.

[2]Kozmetsky and Kircher, Electronic Computers and Management Control, pp. 139-167.

system must keep all levels of management completely informed on all pertinent developments in the activity which affects them. It is vital that the proper information be collected and that reports be tailored to meet the exact needs of the executive receiving them. The emphasis is on the information generated, rather than on the data being processed. The ultimate objective is a management information system which keeps management properly informed on a timely basis; not necessarily a total system automatically controlling the entire activity. The main concern in this thesis has been the identification and review of the needs for operations management of the data processing center.

It has been seen that the next major step, after determining the objectives for the data processing operation, is the development of a plan to accomplish these objectives. The normal approach in the development of a plan of actions follows these steps:

1. Determine information needs for the managers.
2. Translate information requirements to report presentation with emphasis on content and frequency.
3. Establish relationships of report requirements both intra- and inter-department.
4. Develop integrated procedures to collect, process and report management information.
5. Establish installization schedules designed to provide optimum timing

of all procedures.

6. Follow up to assure objectives are met. [1]

The information requirements of operations management do not differ greatly from that categorized for any business activity by J. Brooks Heckert, Professor of Accounting, Ohio State University. The following is Heckert's breakdown:

> Planning and Coordination -- Information required to aid management in determination of policies and to organize a program to carry out these policies.
>
> Control -- Information needed by management to direct and control a business. This would consist of standards, reports on performance and analysis of the relation of cost, and results.
>
> Protection -- Information to provide protection against hazards of business. This would comprise records of business transactions and accountability. [2]

Although the above information requirements are general in nature, there is little doubt that the same information is required by operations management. Once the necessary information requirements are determined, it is necessary to translate the data into a form most suitable for the individual manager. Exception reporting may suffice for the operations manager; however, more detailed information would be required at the operating levels.

As one has seen, the key to administering an efficient data processing operation lies in recognizing it as a production operation; the approach to assure success should therefore be no different from that used in any

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[1] Ibid.

[2] B. W. Ziessow, "Managing the Data Processing Operation," Data Processing for Management, March, 1964, p. 10.

other business undertaking. There are three basic types of controls which must be recognized:

1. Financial and budgetary controls
2. Operating controls
3. Internal controls[1]

The financial or budgetary controls established for a data processing activity are the same as those accorded other segments of a business.[2] The first step is the preparation of a calendarized operating budget. There are two basic concepts of budgeting and reporting the operating results of the data processing organization: the burden center and the profit center. The burden center method considers the data processing activity as a service organization, similar to a quality control department, controller's office, production control office, purchasing department, etc.[3]

The profit center approach presumes that the data processing center will be operated as a service center.[4] Rates, usually competitive, are established for services provided. These rates are then applied to each application on the basis of actual processing time to determine charges which are billed to customers each month.

It has been shown that necessary controls must be established within the data processing center to assure that information is processed and

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[1]Ibid., p. 12

[2]Ibid., p. 13.

[3]Ibid., p. 12.

[4]Ibid., p. 13.

submitted in accordance with established schedules. One categorized the controls that have been established as scheduling controls, procedural controls, data controls and operator controls. Scheduling controls must include a daily log used for scheduling jobs through the operations organization; an operating schedule used to control all data received and all output generated; and machine utilization and employee activity records used to record actual machine time and clerical hours spent on each application. These latter records are also useful in controlling efficiency, and in estimating processing time for new applications.

The establishment of procedural controls is a prime requisite to the operating efficiency of a data processing center. It is important that complete and detailed operating instructions be documented in procedural manuals for effective and efficient operation. There are usually three general types of procedures:

1. Activity instructions -- procedures which are contained in activity-wide instruction manuals. These procedures are broad in nature and contain policies, rules, routines and overall responsibilities.
2. Data processing procedures -- detailed procedures covering each data processing application to assure uniformity of activity practice.
3. Operating instructions -- detailed instructions used within the data processing center. These instructions include card punching and verifying instructions, card layout forms, operational flow charts, standard operating

instructions, tape assignment procedures, program listings, block diagrams and other similar instructions necessary to establish positive control over operating routines.[1]

A well managed data processing center must have a rigid magnetic tape control system that provides for individual reel identification and effective library routines. At a minimum, the tape control system must provide for identifying each reel both externally (visible label affixed to each reel), and internally by means of a tape header, as the computer prints the tape label at the beginning of each computer run.

No data processing center is better than its operating personnel. Console operators must know the operating phases of the system, and must be familiar with the utility programs which are used to resolve unexpected conditions, fulfill special requests, and detect error conditions. In addition, operators must be familiar with all procedural manuals and operating instructions. Operators are also responsible for the control of all input data; for recording the operation in the utilization log which must show set-up, production and elapsed time; and for reporting completion of jobs.

Good internal control considers it essential that no one employee have complete control over substantially all phases of a transaction. This concept does not seem compatible to an integrated data processing system

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[1]Approach used by Activities reporting to the Naval Supply Systems Command.

wherein the entire function is concentrated within the data processing equipment, with a relatively small number of employees operating the equipment. [1]

To attain the most efficient computer utilization and still retain adequate internal controls, the flow of data within an activity must be controlled. This can be done by separating the initiation of data into the system (input), the processing and accumulating of data (operations), and the ultimate summary recording and review of data.

Input controls are concerned with insuring that input data properly reflects all transactions, and that they are properly authorized for processing. This is done by accumulating control totals prior to introducing data into the system, and by insuring properly transcribed data. Accumulating control totals insures processing of all data, and provides a basis for subsequent summary checking of processing accuracy.

Output controls determine that the processed data are correct and do not include any unauthorized alternations. Output control techniques include: comparison of control totals, control by exception, and systematic samples. The primary question of concern in this thesis is: Is it possible to develop a practical integrated management information approach, for the production function of the Data Processing Center, which will both provide necessary operational control, and satisfy the information requirements of higher authority? The answer is a strong

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[1] Ziessow, "Managing the Data Processing Operation," p. 14.

affirmative. The Naval Supply Center, Pearl Harbor approach (based on a job code control technique) is an example of an integrated system which is operational. It is important to note, however, that there are both external and internal requirements for management information from a Data Processing Center.

What are the requirements for management information by management sources external to the Data Processing Center? The answer to this question is divided into two requirements: external to the activity (higher authority), and external to the data processing center but internal to the activity. The information requirements for higher authority in the Government are related to two general areas: equipment utilization, and data processing costs. Similar information is also required at the activity level; but, in addition, there is a need to provide operating management output which is in accordance with a reliable schedule. Since this information is also necessary for efficient and effective management at the computer center level, a single systems approach is possible.

The third research questions is concerned with the requirements for management and operational information within the Data Processing Center, in order that the production function of data processing be accomplished accurately, efficiently, economically and timely. The answer to this question lies in recognizing that the data processing operation is a production operation; and therefore, the approach to assure success should be

no different than that used in any other business undertaking. There is a need for the Operations manager to understand and apply basic management functions to the operation. There is a need to formalize objectives of the overall production operation and to set the policies to be followed in their attainment. There is a need to establish a plan of action to achieve these objectives. Finally, there is a need to develop and install necessary controls to insure efficient operation. There are three basic types of controls which are essential to the data processing center: financial, operating and internal controls. According to Roger L. Sisson and Richard G. Canning, the operation of an information-processing system involves problems of activity scheduling, machine utilization and quality control.[1] In order to solve problems of this type, it has been suggested that Operations management is concerned with six subsystems: data management, equipment operation, planning and scheduling, performance analysis, hardware and software analysis, and stock control management. These subsystems are the foundation in effective computer room management.

Advantages of Integrated Management Information System for Operations managers are many. This thesis has discussed these advantages; some of which follow: a central source for all management information in the data processing center (production, scheduling, utilization, and cost); cost savings through improved planning of manpower and machine utilization; improved customer relationships; a customer-computer center

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[1]Canning and Sisson, A Manager's Guide to Data Processing, p. 24.

coordinated plan; an approach to the evaluation of the computer center with regard to activity mission; assigned responsibility for specific application areas; and improved communications.

It has been shown that computer operations pertain to the actual day-to-day functioning of the centralized data processing equipment, i.e., machine scheduling, operation and maintenance. This component usually provides keypunching services, machine processing of established and developmental application programs, and preparation of output in usable form. One has seen that typically, computers have been the administrative responsibility of the financial component of an activity. While this has been an appropriate organizational location for the computer, there are conditions under which this arrangement impedes rather than facilitates effective exploitation of the computer's potential. One has seen that data processing operations are constantly in need of improvement. While this statement would appear to be a postulate, data processing managers often are not aware that a planned and controlled program for improvement is as important to accomplishing their ends, as is the effort expended on recurring system development or machine operations. Too many of these managers believe it is easier to put out fires than to develop a fire prevention program. Too often the manager of data processing operations has not progressed from punched card operations to the sophisticated needs of computerized data processing.[1] Other managers are not willing to afford

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[1] Jack D. Beeny, "Evaluation and Improvement of Data Processing Operations," Data Processing Management Association. Vol. XI, 1966, p. 302.

the effort and cost to design and develop a method for improvement of operations and to create the environment in which this method would be effectively applied.

Applying Murphy's Law, one finds that no organization applies computer data systems as poorly as does a computer center.[1] M. L. Rubin also has indicated that the data processing operation has not developed the integrated management system which is necessary for the third generation of equipment.[2] With the increased problems of scheduling and controlling the computer center operation as a result of increased equipment capability, it is essential that operations management develop an automated approach to assist in management control of the computer center. This system must be an integrated approach to combine elements of data management, equipment operations, planning and scheduling, performance and utilization, and stock management. This data processing management information system must also provide the information requirements for higher authority.

It must be emphasized that the development of this system is no small job which can be undertaken as part time effort. The development of an integrated management system for data processing management will require considerable planning and research. This thesis has set forth the needs for an integrated management system for the data processing center in order that production is timely, economical, accurate and efficient.

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[1]Ibid., p. 316.

[2]M. L. Rubin, "Design of a Time Recording and Charging System," Data Processing Management Association, Vol. XIII, 1968, p. 269.

APPENDIX A

DEPARTMENT OF THE NAVY AUTOMATIC DATA PROCESSING PROGRAM REPORTING SYSTEM (SECNAVINST 10462.12A)

The Department of the Navy Automatic Data Processing Program Reporting System is part of a Governmentwide system for informing management at all levels concerning cost, inventory, and use of automatic data processing equipment.[1] The information obtained from this system is used to guide allocation of attention to ADPE management, assist in negotiating improved terms and conditions for Federal Supply Schedule contracts, isolate improper utilization practices, gauge sharing potentials, assess reutilization possibilities, evaluate equipment purchase opportunities, project budget requirements, and otherwise assist in effective management of ADP resources. It is essential that the data provided through this system be processed expeditiously and be maintained in consistency with other submissions of data concerning ADP costs, inventory, and use.

All elements of the Department of the Navy involved with automatic data processing are covered by this reporting system and are considered ADP units, whether or not equipment is installed. Specifically, reports are required from organizations which:

1. Use ADP equipment.

2. Acquire or plan to acquire ADP services from Government or other shources. These services include machine time, operations, and maintenance; systems analysis and design; programming; training; and studies or advice on equipment acquisition, selection, and use.

3. Perform ADP functions such as coordinating ADP programs and activities; developing, programming, and implementing systems; reviewing, recommending, or selecting ADP equipment; approving the acquisition of ADP equipment or services; or providing ADP services on a consulting or project basis.

The following are data elements and the various reporting data which is required in the report. The report is divided into various cards as listed. The data elements are being listed to indicate what information is required by higher management with regard to data processing. It is concluded that all required information should be available to data center operation management.

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[1]Parts of SECNAVINST 10462.12A are provided to indicate top management requirements as related to Operations Management.

Card A and B

Card A, taken together with card B provides identifying information on the reporting ADP unit. No special data processing management information is required and therefore these data elements are not provided.

Card C

Card C is used to report inventory of installed ADPE and actual EDPE system gains and losses. A complete inventory of installed EDPE and PCAM will be prepared reflecting anticipated on board status as of June 30 of each year. Actual EDPE gains are reported immediately after installation of an EDPE system. Actual EDPE losses will be reported immediately after an EDPE system is released.

Inventories are required at the component level. Components are individual machines which are acquired to operate independently or as an integrated group or system. Although variation in terminology exists among manufacturers, individual machines are generally identified by type and model numbers. Special features, accessories, or machine capacity increases which are installed on EDPE components or PCAM should not be reported. Again, this is information which the operations manager can obtain when equipment is installed and does not require any special information collection. It therefore is not necessary to include the specific data elements for card C.

Card D

Card D reports utilization of EDPE Systems in place at the close of the reporting period. Utilization data will be prepared on the basis of average monthly utilization of each central processor during the preceding reporting period, or portion thereof for computers installed less than the entire period. When equipment is not installed for the entire quarter, convert utilization figures to represent a one month average, e.g., if equipment is installed for 15 days, double the actual hours of utilization; if installed two months, halve the actual utilization, etc.

Utilization data is required for EDPE central processing units only. One D card should be submitted for each EDPE central processing unit; none for other EDPE components nor for PCAM.

Reporting data elements card D:

1. Card Code

2. Address Code

3. Command/Bureau Code

4. ADPE Manufacturer

5. EDPE System

6. EDPE System Identification Number

7. Hours Out of Service

   a. Preventive Maintenance: Average monthly hours during the reporting period used for scheduled preventive maintenance.

   b. Remedial Maintenance: Average monthly hours during the reporting period for nonscheduled repairs, including time awaiting repairs.

   c. Other Downtime: Average monthly hours during the reporting period lost due to failure of electricity, air conditioning breakdown, excessive humidity, maintenance or modification of physical facilities, combat operations, unit movement, EDPE field engineering changes, etc.

8. Hours in Service

   a. Set-up: Average monthly hours during reporting period not available due to loading or unloading EDPE with cards, paper, tapes, etc. Set-up which takes place during other productive operations is not to be reported. Set-up represents the difference between the total of elapsed time for each job and the total of meter time for each job, if an operational use time meter is used.

   b. Rerun -- Manufacturer: Average monthly hours during the reporting period used in reruns due to machine error or software for which manufacturer is contracually responsible.

   c. Rerun -- Other: Average monthly hours during the reporting period used in reruns due to data, operator, program, tape, or other error for which the manufacturer is not responsible.

   d. Program Development: Average monthly hours during the

reporting period used in program, development and modification.

e. Effective Production: Average monthly hours during the reporting period of operational use time excluding Rerun -- Other and Program Development. Job run in parallel should not be counted independently. If production and program development are run in parallel, report as effective production.

9. Hours Not Available

a. Hours Not Available: Average unused monthly hours during the reporting period which could not have been made available for use by others. The data desired is that average monthly number of unused hours which would nevertheless not have been available to others for reasons. "Hours not available" could never exceed the remainder resulting from subtraction of the hours accumulated from the total number of hours in the month.

b. Reason for Nonavailability: Indicate primary reason why the hours not available could not be made available to other organizations.

1. Workload contingencies

2. Real-time system

3. Reserved for mobilization

4. Time fragmented -- not available in period greater than one hour

5. Other

c. Number of Shifts: Number of 8-hour shifts per day the EDPE is scheduled on a five-day-week basis. If, as is sometimes the case in contractor installations, the EDPE is accessible on a nonscheduled basis for more than the normal working day, indicate the number of shifts which could be accommodated in the time the EDPE is accessible.

10. Hours Provided to Others: Average monthly hours during the reporting period provided to any organization (whether or not in the same Federal agency), where the hours provided are not a part of

the assigned mission and are not included in the funding and staffing of the providing ADP unit.

a. Reimbursable Hours

b. Nonreimbursable Hours

11. Hours obtained from Others: Average monthly hours during the reporting period obtained from any other Government ADP Unit (whether or not in the same Federal agency) or commercial source on equipment.

a. Reimbursable Hours

b. Nonreimbursable Hours

c. Commercial Source Hours

12. Projected Utilization -- Current Fiscal Year

a. Hours in Service: Estimated average monthly hours to be in service for remainder of current fiscal year while system is installed in reporting unit. Leave blank when reporting date is "as of" June 30. This field plus the field following cannot exceed 730 hours (732 hours is leap year). Since hours out of service are not included in either of these fields, the total should typically be less than 730 hours.

b. Hours Available: Estimated average monthly hours to be available to other organizations for remainder of current fiscal year while system is installed in reporting unit. Hours which are specifically planned to support known customers are reported as hours in service rather than as hours available. Leave blank when reporting date is "as of" June 30.

c. Hours to be Obtained from Commercial Sources: Estimate average monthly hours to be obtained from commercial sources on equipment.

13. Projected Utilization -- Budget Year

a. Hours in Service: Estimated average monthly hours in service during the budget year while system is installed in reporting unit.

This field plus the field following cannot exceed 730 hours (732 hours in leap year). Since hours out of service are not included in either of these fields, the total should typically be less than 730 hours.

b. Hours Available: Estimated average monthly hours to be available to other organizations during the budget year while system is installed in reporting unit. Hours which are specifically planned to support known customers are reported as hours in service rather than as hours available.

Card E

Card E is used to report the acquisition history of EDPE Systems acquired from suppliers. Acquisition history reporting commences with EDPE Systems completing the performance period and qualifying as accepted subsequent to July 1, 1967. Again, this information does not require operations management decisions and therefore is not included in this Appendix.

Cards F, G and Q

Cost and manpower for each ADP unit for the fiscal year just past are reported on F and G cards, with Q cards added to spread the cost on a percentage basis among information systems and applications.

Cost and manyear data should be summed and reported for two categories of personnel:

a. All civilian and military personnel assigned to the organization which is identified by its title with the data processing function. This would include the Data Processing Department or Division. All personnel assigned to this organization are to be counted, whatever their duties, classification, or tenure may be.

b. All civilian within the activity but outside the data processing organization who are classified in the series listed below and any civilians not in the classified service or military personnel performing comparable duties outside the data processing organization but within the activity.

GS-330	Digital Computer Systems Administration
GS-332	Digital Computer Systems Operation
GS-333	Peripheral Computer Equipment Operation
GS-334	Digital Computer Systems Specialist

GS-335	Digital Computer Aide and Technician
GS-336	Card Punch Operation
GS-359	Electric Accounting Machine Operation
GS-362	Electrical Accounting Machine Project Planning

Reporting Data Elements Card F

1. Card Code F

2. Address Code

3. Command/Bureau

4. Total Manyears (excluding overtime)

   a. Civilian Manyears: The total manyear equivalent of all civilians included in categories above.

   b. Military Manyears: The total manyear equivalent of all military personnel included in categories above.

5. Manyears by Function: Since manyears may be reported in the two total manyear fields for personnel who do not fall into any of the categories shown below, the total of the manyears by function fields will typically be less than the total of the two preceding fields. The difference reporesents personnel in administrative, clerical, and other functions not covered by the listed categories. The total of manyears by function may be less than or equal to the military and civilian total. It can never be greater than the military and civilian total.

   a. Systems Analysis/Design Manyears: Enter the total manyears (combine fractional manyears where necessary) of all personnel engaged in systems analysis/design functions including the supervision thereof. If combination analyst/programmers are used, appropriate portions of their time should be shown in this field and the one following.

   b. EDPE Programming Manyears: Enter the total manyears (combine fractional manyears where necessary) of all personnel engaged in EDPE programming functions including the supervision thereof. Include manyears for PCAM project planning.

   c. ADPE In-House Maintenance Manyears: Enter the total manyears (combine fractional manyears where necessary) of all personnel

engaged in ADPE in-house maintenance functions including the supervision thereof. Include only in-house personnel involved in equipment maintenance. Personnel engaged in program maintenance should be reported under programming manyears.

d. Keypunching/Verifying Operation Manyears: Enter the total manyears (combine fractional manyears where necessary) of all personnel engaged in keypunching/verifying operations including the supervision thereof.

e. Other ADPE Operation Manyears: Enter the total manyears (combine fractional manyears where necessary) of all personnel engaged in other ADP equipment operations including the supervision thereof. Include all console operators, peripheral equipment operators, and punched card machine operators, other than keypunch and verifier operators. Do not include tape librarians, schedulers, or others who do not operate or supervise the operation of ADPE. Such personnel fall in the category of those reported in military and civilian totals but not reported in manyears by function.

f. ADP Management Manyears: Enter the total manyears (combine) fractional manyears where necessary) of all personnel engaged in evaluation and selection of ADPE, including the supervision thereof.

6. Capital Costs (rounded to nearest thousands of dollars)

a. EDPE Purchases: Enter the costs of all purchased EDPE (whether or not peripheral to a central processor) which were or will be obligated during the fiscal year being reported. This should be net cost, reduced by any rental credits applicable.

b. PCAM Purchases: Enter the costs of all purchased PCAM which were or will be obligated during the fiscal year being reported. This should be net cost, reduced by any rental credits applicable.

c. Other Equipment Purchases: Enter the cost of other types of equipment which are unique to the support of ADP operations (e.g., bursters, decollators, magnetic tape cleansers and certifiers, special printout duplicators, etc.).

d. ADPE Site Preparation: Enter the cost of construction, major repairs, alterations, and minor construction projects accomplished or anticipated for ADP Unit operations.

7. Operating Costs -- In-House (rounded to nearest thousands of dollars)

   a. Civilian Salaries and Overtime: Enter the sum of the salaries and overtime of all civilian personnel described under "Personnel Coverage." Exclude Government contributions in behalf of employees to a retirement fund, health plan, etc.

   b. Military Base Pay and Allowances: Enter the sum of the base pay and allowances of all military personnel described under "Personnel Coverage." Use rates established by NAVCOMPT Manual 035750.

   c. EDPE Rentals: Enter the sum of the basic rental costs and extra use charges for leased EDPE

   d. PCAM Rentals: Enter the sum of the basic PCAM rental costs and extra use charges for leased PCAM.

   e. Magnetic Tapes and Disk Packs: Enter the costs of magnetic tapes and disk packs, whether purchased or leased.

   f. Maintenance Parts and Equipment: Enter the cost of all parts, tools, engineering drawings, and test equipment purchased for in-house maintenance of ADPE.

   g. Supplies: Enter the cost of all supplies purchased for ADP functions in the ADP Unit, e.g., paper tape, punch cards, ribbons, etc.

   h. Other: Enter other operating costs of the data processing installation such as travel and per diem of personnel, equipment transportation, and separately billed state and local taxes on ADPE. Do not include cost of electricity or other utilities, industrial relations service, Government contributions to retirement funds, health plans, etc., or other such overhead charges.

Reporting Data Elements Card G

1. Card Code G

2. Address Code

3. Command/Bureau

4. Operating Costs -- Contractual Services (rounded to nearest thousands of dollars): The operating costs to be reported in the fields below are limited to the actual contractual costs for ADP services obtained from other than Federal Government sources.

   a. ADPE Time and Related Services: Enter the cost of obtaining time on ADPE (other than on in-house equipment) or of obtaining a product from ADP machine processing. This includes operator costs but specifically excludes keypunching and verifying.

   b. Systems Analysis/Design and Programming Services: Enter the cost of systems analysis/design and programming services.

   c. ADPE Maintenance: Enter the cost of ADPE maintenance contractual services.

   d. Keypunching/Verifying Services: Enter the cost of keypunching/verifying services. This includes any charge for equipment, as well as labor cost.

   e. Other: Enter the cost of other contractual services obtained which are not specifically identified above, e.g., cost of ADP library services, studies or advice on ADPE acquisition, selection, and use, etc.

5. Operating Costs -- Reimbursable Services (rounded to nearest thousands of dollars): The operating costs to be reported in the fields below are limited to the costs of ADP services obtained from other Federal ADPE Units, or organizations (whether or not in the same Federal agency).

   a. ADPE Time and Related Services: The cost of obtaining time on ADPE (other than on that of the reporting unit) or of obtaining a product from machine processing. This includes operator costs but specifically excludes keypunching and verifying.

   b. Systems Analysis/Design and Programming Services: Enter the cost of systems analysis/design and programming services.

   c. Keypunching/Verifying Services: Enter the cost of keypunching/verifying services. This includes any charge for equipment, as well as labor cost.

d. Other: Enter the cost of other reimbursable services obtained which are not specifically identified above, e.g., equipment evaluation and selection services, equipment maintenance, etc.

e. Gross Cost (rounded to nearest thousands of dollars): Enter the sum of the operating costs and the capital and operating cost of the corresponding F card.

6. Less: Receipts for ADP Services Provided to Others (rounded to nearest thousands of dollars) The funds received for ADP services provided to others are shown. This should not include transfer of funds within the activity.

a. ADPE Time and Related Services: Enter the funds received in return for machine services or time provided.

b. Systems Analysis/Design and Programming Services: Enter the funds received for systems analysis/design and programming services.

c. Keypunching/Verifying Services: Enter the funds received for keypunching/verifying services.

d. Other: Enter the funds received for other reimbursable services provided to others which are not specifically identified above.

e. New Cost: Enter the gross cost minus the sum of the reimbursable services provided.

f. Civilian End Strength: Enter the number of civilians described under "Personnel Coverage" actually employed at the end of the fiscal year.

Reporting Data Elements Card Q

1. Card Code

2. Address Code

3. Command/Bureau

4. System Code: Enter the code of one system or application. Must contain four alphanumeric characters.

5. Purchase Percentage: Enter the percentage figure which, when multiplied by the sum of the fields 6a, 6b and 6c of the corresponding F card, will give the total cost of purchases allocable to the system identified in 4 of the Q card.

6. Site Percentage: Enter the percentage figure which, when multiplied by the data in 6d of the corresponding F card, will give the total cost of site preparation allocable to the system identified in 4 above.

7. In-House and Reimbursable Operating Cost Percentage: Enter the percentage figure which, when multiplied by the sum of fields in 7 of the corresponding F card and 5 of the corresponding G card, gives the total in-house and reimbursable operating cost allocable to the system identified in 4 above.

8. Commercial Contract Percentage: Enter the percentage figure which when multiplied by the sum of fields in 4 of the corresponding G card, gives the total commercial contract cost allocable to the system identified in 4 above.

9. Analyst Manyear Percentage: Enter the percentage figure which, when multiplied by the data in 5a of the corresponding F card, gives the total number of analyst manyears allocable to the system identified in 4 above.

10. Programming Manyear Percentage: Enter the percentage figure which, when multiplied by the data in 5b of the corresponding F card, gives the total number of programming manyears allocable to the system identified in 4 above.

APPENDIX B

DATA PROCESSING MACHINE UTILIZATION AND CONTROL SYSTEM FOR NAVAL SUPPLY CENTER, PEARL HARBOR

I. INTRODUCTION

As is well known, the Data Processing Department is a service organization. As a consequence of this function, DPD has approximately 500 separate and unique jobs that it performs for its NSC and reimbursable customers. Considering that some of these jobs recur on a daily and weekly basis, DPD processes approximately 2,000 separate jobs within any given month. The term approximately is used because Data Processing is such a dynamic function that not a week goes by that these figures do not change, normally in a upward direction.

The term "job code" is fully explained in the enclosed documentation. However, it is, generally speaking, an identifiable set of steps that begins with an input and ends with an output. This set of steps might be highly involved, including keypunching of cards, EAM preparation of cards for input to the computer, up to 4 or 5 runs on any one or all three computers and EAM preparation of output prior to delivery to the customer; or, it might simply be a sort of some cards for a customer. However, considering that there are 500 such sets of steps and that they recur 2,000 times a month, it is obvious that no one person or group of persons can be expected to remember all the details involved in getting these jobs accomplished.

And this brings us to what is a basic problem of any organization that has such a large and varied workload: control. It is essential that DPD be in a position to answer five questions each and every day:

1. What input is due in today?
2. What input is late as of today and why?
3. What input is to be processed today?
4. What output is due out today?
5. What output is late as of today and why?

We cannot function properly if we cannot answer these questions.

Over the last year and a half we in DPD have been implementing what we call the job code system of control. It may or may not be unique, but

it is effective when used properly. The job code system is fully outlined in the enclosed documentation. However, it is obvious that the simple assignment of this job code does not answer our five basic questions. And this brings us to the system we have devised for using these codes.

The Data Processing Department is broken down into four major areas: (1) Staff; (2) Analysis and Programming, which we can here disregard if we assume that they will always furnish us with adequate documentation; (3) Input and Output Control, which will be referred to as Clerical and is essential to the working of the system; and (4) Operations, which contains the Production Control Branch which is also essential.

In order to work, the system requires a central input and output control point. Also, the customer should have one point which he can contact to obtain status or other information concerning his jobs. This responsibility has been assigned to Clerical. They are furnished on a monthly basis a planning schedule which reflects by day the jobs that are due in and the jobs due out during the forthcoming month. They must log in all input and immediately assign the proper job code. This job code will be used by all processing areas to determine the procedure to follow. They must follow-up on all late input and late output and be in a position to answer questions concerning the current status of any job. They must furnish Production Control a list of all input daily so that Production Control will know which jobs can be scheduled for the next 24 hour processing period. They must log all outgoing jobs so that the record is complete. Clerical is also furnished a listing of output products by job code so that they can check to insure that all portions of a job were completed and that it is sent to the correct department. Clerical has the initial responsibility and are the final check on all jobs processed within DPD. It is Clerical that can determine to a great extent the worth of the system. This is because, for various legitimate reasons, input does not always arrive in DPD as scheduled, customers often wish to change the run date or, again for various reasons, output does not always go out as scheduled. We must keep control of these situations. The responsibility then rests mainly with Clerical to answer our five questions. However, they cannot do the whole job and once a job is received and is ready for processing it becomes the responsibility of a branch within Operations: Production Control.

At 1430 each day Operations has what is termed a scheduling meeting. The meeting is chaired by the head of Production Control and is attended by a representative from Clerical, the two production controllers, and each section supervisor. Clerical informs the Production Controllers of all input, by job code, received that day. Clerical receives any information

concerning late jobs and/or any possible trouble or questionable areas. Using the information furnished by Clerical and the monthly planning schedule, Production Control then compiles a schedule that covers 16ØØ that day to 16ØØ the following work day. A separate schedule is produced for each computer and for EAM. Production Control in conjunction with management also indicates on the schedule the priority of events. This becomes critical during periods when more than 24 hours of scheduled work are to be processed. As can be seen, Clerical and Production Control act as a check of each other. Since both sections are using the planning schedule they are in a position to check on each other to make sure that when a job is due in or out that someone knows it and is checking if something is out of the ordinary. Consequently, Clerical in conjunction with Production Control should be in a position to answer all five of our essential questions.

The enclosed documentation outlines completely DPD's Machine Utilization and Control System. It may appear to be and is in fact redundant in some areas. However, it will answer almost all questions concerning the system. It is essential that all supervisors familiarize themselves with the information contained therein and to encourage all personnel to support the system. It is a good system, it works, and it is to be the benefit of all concerned to abide by and support the system and to suggest areas that might be improved.

II. DEFINITIONS

JOB CODE

A four character identification code used to control and cost the accomplishment of various tasks associated to a specific output report. The following is a breakdown of these four positions:

1st position. An attempt has been made to approximate NAVSUP Application areas.

A = Administrative Management and Machine Utilization
E = Financial Inventory Control
F = Stores Accounting
G = Cost/Allotment/Appropriation Accounting
J = Shipment/Delivery
K = Payroll
L = Customer Information
M = Receipt/Due Processing

N = Issue/Demand Processing
P = Inventory Control
Q = Purchase
R = Management Reporting
T = Quality Control
V = Excess Disposal
W = Records Maintenance
Z = Personnel Services
1 = Software Control/Utilities
3 = Misc. Non-Reimbursable
4 = Cost/Allotment/Appropriation Accounting (LOCAL)
5 = Pacific Division
6 = OPEN
7 = Misc. Reimbursable
8 = NRFC (Navy Regional Finance Center)
9 = PWC (Public Works Center)

JOB STEP

The smallest unit of work effort to be performed in accomplishment of an output. The job steps will be the sequence of events necessary to accomplish the output.

APPLICATION

Assigned by NAVSUP for control of ADP Cost.

RUN NUMBER OR PROGRAM

A 3, 4, or 5 digit number assigned to identify a computer object deck.

PRODUCTION RUN

The requirement to generate a specific output which has an established due-in date, due-out date and frequency.

FREQUENCY CODE

The established time frames in which a given job code is to generate an output. Following codes apply:

1. DAILY or more often than once weekly.

2. WEEKLY (work day in and out)

3. BI-WEEKLY (payroll week) (work day in and out)

4. MONTHLY (Can be either calendar day in and out or workday in and out or a combination of either.)

5. QUARTERLY (Necessary to indicate the month (1 to 3) the report is required.)

6. SEMI-ANNUAL (Necessary to indicate the month (1 to 6) the report is required.)

7. ANNUAL (Necessary to indicate the month report is required.)

8. BI-WEEKLY (not payroll week) (work day in and out)

9. As Required (must be data driven)

CLERICAL CODES

A code used to identify the flow of workload into or out of the Clerical Division. These codes cause the job code to appear on the respective clerical schedule.

O Used to indicate output goes out through Clerical

I Used to indicate input comes in through Clerical

B Both of above cases are true

COMPONENT

A breakdown of the operations work effort

1410	Computer System
1401	Computer System
360/20	Computer System
EAM	Operation
KP	Operation
Remote	Operation

SHIFT ASSIGNMENTS

Shift 1: Approximate ØØØ1 to Ø8ØØ (Midnight)
Shift 2: Approximate Ø73Ø to 16ØØ (Day)

Shift 3: Approximate 16ØØ to 24ØØ (Swing)
Shift 4: Overtime
Shift 5: Comp-time earned or taken
Shift 6: Holiday Leave

DAILY COMPONENT SCHEDULE

The workload scheduled for a specific component for accomplishment from 16ØØ one work day to 16ØØ the following work day and including both the daily workload (on preprinted form) and the non-daily workload (a listed form). This schedule is to include job code, run number, due in day, due out day, noun name and priority if required.

OPERATION CODE

Used to identify the machine time consumed or machine idle time.

Blank - Production Run
0 - Test/UADPS
1 - Test/Local
2 - Test/Reimbursable
3 - PM
4 - Downtime
5 - Rerun (Machine Failure)
6 - Rerun (Program)
7 - Rerun (Other)
8 - Machine Idle (used with J. C. A017)
9 - 141Ø Investigation

III. PROGRAMS USED IN THE DPD PRODUCTION CONTROL AND UTILIZATION SYSTEM

1. 36Ø Program Ø4555
Validates Machine and Labor Utilization cards and extends elapsed time.

2. 36Ø Program Ø4562
Creates Labor cards from KP and ADP detail cards.

3. 36Ø Program Ø4558
KP daily Backlog report and weekly MEP Standard Report.

4. 36Ø Program Ø4559
KP report of non-standard cards punched - (weekly).

5. 36Ø Program Ø4557
Weekly KP production statistics by badge number.

6. 36Ø Program Ø455A
Recap of EAM and ADP Machine and Labor Utilization for MEP reporting.

7. 36Ø Program Ø4556
Weekly Reconciliation by badge number for Sections 1 and 2.

8. 36Ø Program Ø4554
Weekly Reconciliation by badge number for Sections 3, 4 and 5.

9. 36Ø Program Ø4567
Monthly metered hours by day by component for Section 2.

10. 36Ø Program Ø4568
Monthly percentages by Operations code by component for Section 2.

11. 36Ø Program Ø4566
Monthly handling time report by component by Job Code for Section 2.

12. 14Ø1 Program Ø471 puts meter cards, labor details and machine details on tape in one run.

13. 141Ø Program 212. Program 212 is used to update the master machine utilization file with average run time and volume information. This information can then be used to update the planned cost data.

14. 141Ø Program 214 accumulates time by component from meter cards. Also accumulates time by machine type from M/U detail card. Matches all details (machine) against master M/U file by job number and creates detail type records for machine time. Labor details are put into detail tape format without matching against master.

After all input is read, balances recorded time for 141Ø, 14Ø1, and 360 (from machine details) against metered time for 1411, 14Ø1, and 2Ø2Ø respectively, and creates adjustment record for any excess or deficient time. Uses metered time for computer components and recorded time for EAM, with actual rental rates, to prepare "ADP Costs and Utilization" report and average rental rates. These average rates are put on the output tape.

15. 141Ø Program 215 makes adjustment to a job code and a program number using either input cards (prepared by scheduler) to distribute time or standard number (stored in program) to assign all excess or deficient time to a job and program number. Prepares "Computer Production Report."

16. 141Ø Program 216 matches tape details for machines against master M/U file, prints "M/U by Job Code" using planned time from master and actual time from detail and previously computed average rates (from input tape), and forms rental summary on output tape (including job code description from master). Forms labor summary on output tape with tape detail for labor matched against master M/U file. Selects all tape details for machines with blank operation codes (production runs) and accumulates data on number of times run, total time run, and total volume run. This data is used for a statistics record on an output tape to be used in an updating run quarterly.

17. 141Ø Program 217 prints "Labor and Rental by Job Code" using labor and rental summaries. Accumulates time by computer by operator code for "Machine Use" report. Accumulates time and cost by computer by application code for application summaries. Prints "Machine Use" report and punches application summaries.

18. 141Ø Program 218 will be run once to create the master M/U file. It will be run as required (at least once quarterly) to update the master M/U file. The file is on tape and is created from and updated by cards.

19. 141Ø Program 219 will be run once a month to produce the planning schedule for the following month. It will also prepare two clerical schedules; one listing all job codes by due out date, the other listing all job codes by due in date which have been identified as being processed by the Clerical Division.

20. 14Ø1 Program Ø47Ø prints the output tape from program 219 after it has been sorted by program 219S.

IV. GENERAL CONCEPTS

1. Objectives: The objective of the Data Processing Production Control and Utilization System is to provide:

   a. Data processing service that is economical, prompt, accurate and responsive.

b. Management data which is accurate and timely in order that Supervisors can make operational decisions before a problem becomes critical.

2. System Specifications

a. Data Processing Master Data File - The basic source data of the Data Processing Production Control and Utilization System is a tape data file of all job codes for production runs accomplished by the department. The file is in sequence by job code and includes in the master record job description; application code; number of job steps; the due in and due out dates (either by calendar or workday), and a Clerical control code. Each production job code will also have job step trailer records which will be in the sequence for completion of the job. These job steps indicate the order in which the job is to be completed and contain the equipment the job is to be run on, the run number, and average run time to accomplish that run.

In order to provide a control for input into the Data Processing Master Data File as well as insure that all necessary operation tools are available, the DPMDF form was established. This form is completed by the Production scheduler when a job code is assigned for Production runs. A copy of this form is provided the Clerical Division and the Data Processing Customer so that they are aware of the new job code assignment. This approach is to insure that input is identified.

b. Workload Type - In order to facilitate scheduling, workload has been classified into two types:

1. Daily: These job codes have a frequency of more often than weekly and/or input is processed generating output on a daily basis. It can be seen that a daily job code does not need to be run every day but should be accomplished within one day after input is either received or generated.

2. Other than Daily: The job code has a frequency of weekly, Bi-weekly, Monthly, Quarterly, etc. Input is received or is computer generated with output created on a specifically scheduled day. Input is received or output generated from data files for processing in a series of jobs requiring various time frames for accomplishment of outputs generated.

c. Job Code: A four position alpha/numeric code assigned to a task which will identify accomplishment of various job steps to complete a specific output or outputs. Identifies a specific set of job steps, runs, EAM operations or instructions with a specific input and output. See definitions for a further breakdown.

d. Scheduling Phase: On the 25th of the month, the scheduling phase of the system will be run. These are programs 218, 219, and 47Ø. These programs generate:

1. Master Planning Schedule

2. Clerical Due In Schedule

3. Clerical Due Out Schedule

The master planning schedule is a tool for scheduler and operations manager which indicates by due-in-day the job codes which are to be processed. In addition, the planning schedule indicates due-out dates, job name and the average processing times by equipment for each component. The first few pages of the planning schedule provide a listing of the job codes which have been identified as daily workload.

The Clerical schedule indicate only the workload which the Clerical Division is to receive, distribute or both on a given day. As work is received into the department, the Clerical Division is to clearly label the input with the appropriate job code. The job code is to be used by all employees as they complete the labor and machine utilization forms which reflect effort spent on a given job code. Clerical at about 1400 is responsible for providing the scheduler a list of all job codes received as input into the department. In addition, Clerical should provide the scheduler a listing of all workload which has been completed and has left the Data Processing Department. As discussed, there are two types of workload: Daily and Other-than-daily or non-daily. The scheduling and control techniques used to manage these workload type are different.

1. Daily Scheduled Scheduling: A preprinted schedule indicating the job code, run number or numbers and a

noun name are provided. In addition, there are columns which indicate "scheduled" (input received); "in" (received into component) and "out" (completed by component). These columns should contain the date of the required action.

When daily work is received by Clerical, the job code is marked with the date indicating receipt of the workload by job code. This receipt log is provided to the scheduler at about 143Ø along with any additional information which Clerical may have received. From this receipt log, the scheduler prepares the daily preprinted component schedule. This component schedule is tailored to the specific component and will indicate all the job codes which that component has to accomplish under the daily workload definition. If a date appears in the "scheduled" column then the component will know that this workload is coming to the component. When the workload is received by the component, the date is put into the "in" column and when completed the date is again placed in the "out" column. At about 143Ø each day the schedules are returned to scheduling at which time a new schedule is prepared. Prior to turning in the schedule at 143Ø, it is necessary for the operating component to conduct an inventory of all job codes which have been received by the component but has not been completed. When workload is at a peak it would be advantageous for the scheduler to assist the operators in the taking of this inventory. As you can see, there will be a period of time when the operating component does not have a schedule. During this period the machine utilization log should be marked to indicate what job codes have been completed while the schedule is being updated. When the new schedule is provided, the operators must then mark the completed effort.

e. Non-Daily Workload Scheduling: The non-daily jobs will be controlled and scheduled in a similar manner. However, the component schedule will not be preprinted but will be listed. This special schedule will contain the "in" column, "out" column, the priority column, noun name and various run numbers required to complete the job. It will also contain the scheduled due in date and the scheduled due out

date which can be used by the operating component as necessary. Since the special schedule will contain only jobs received by data processing, there is no need for other "scheduled" column. The special schedule will be turned into the scheduler following the same procedures as above. Any difficulty in processing a machine run should be indicated on the schedule. These schedules should be filed (by component) in the scheduling office and should be retained for a period of one year.

f. Utilization Phase: The input into the utilization phase of the Data Processing Production Control and Utilization System is the labor and utilization logs. This data is key punched and used as input into programs 471, 214, 215, 216 and 217. All individuals of the Data Processing Department are required to complete a labor log. This labor log will be completed either on a daily or weekly basis depending upon organizational assignment. All operators of data processing equipment are required to complete the utilization logs. With the exception of the machine utilization logs of key punch, all labor and utilization logs will be forwarded via the supervisor to punch.

The keypunch utilization logs will be key punched and forwarded on a daily basis to EAM for processing of the daily key punch and backlog report.

On a weekly basis (all input received between 0001 Monday and 2400 Sunday) the Operations Division will prepare the Labor and Machine Reconciliation Report. This report provides a detailed breakdown of time by individual by job codes including leave, comp time, etc. It is important to balance the man hours total on this report to about 40 hours (+ 1.5 hours). To arrive at the 40 hour figure, add leave plus compt time taken and subtract overtime and compt time earned. Noet that overtime and comp time earned are included in the total man hours worked. Formula:

> 40 hours = recorded manhours less overtime less comp time earned plus leave plus comp time taken. It is important to note that at monthend it is necessary to balance to the number of hours worked by an individual from 0001 Sunday to 2400 Monthend. And likewise to balance from 0001 month start to 2400 Saturday.

Supervisors are to review the Reconciliation report for the respective areas and submit corrections in order that the input data into the Utilization is accurate.

At monthend the Utilization cycle is run which generates the following reports:

1. Program run time report
2. ADP Cost and Utilization report (1107)
3. Machine Utilization by job code
4. Labor and rental by job code

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